NAVAL POSTGRADUATE SCHOOL
Monterey, California

THESIS

AN ASSESSMENT OF THE NATIONAL DUAL-USE POLICY AND ITS IMPACT ON THE PROGRAM OFFICE

by

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December 1998

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REPORT DOCUMENTATION PAGE

Form Approved OMB No. 0704-0188

1. AGENCY USE ONLY *(Leave blank)*	**2. REPORT DATE** December 1998	**3. REPORT TYPE AND DATES COVERED** Master's Thesis

4. TITLE AND SUBTITLE : An Assessment of the National Dual-Use Policy and its Impact on the Program Office	**5. FUNDING NUMBERS**
6. AUTHOR(S) Albert John Visconti, Sr.	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Naval Postgraduate School Monterey, CA 93943-5000	**8. PERFORMING ORGANIZATION REPORT NUMBER**
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)	**10. SPONSORING/ MONITORING AGENCY REPORT NUMBER**

11. SUPPLEMENTARY NOTES The views expressed in this thesis are those of the author and do not reflect the official policy or position of the Department of Defense or the U.S. Government.

12a. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution is unlimited.	**12b. DISTRIBUTION CODE**

13. ABSTRACT

This thesis examines the current trends within the United States to move towards greater dependence on the commercial sector for military defense. Dual-use technologies impact the Defense acquisition process. It will discuss the risks associated with the migration of a defense industrial base to one of a national industrial base. Research will include conducting a thorough literature search, review of historical dual-use issues as well as defense and commercial initiatives in this area. Dual-use technologies can come in the form of CI or NDI. These items have the potential to save the program manager quite a bit of money, especially in the development costs. However, some would argue that these items might not be able to satisfy the peculiar environment required by the military. Others contend this to be the best method of procurement during this dwindling budget era. As DoD continues to rely on dual-use items, commercial sector initiatives gain momentum, particularly in the form of best practices. The program manager faces numerous challenges in employing dual-use technology.

14. SUBJECT TERMS Dual-Use Technology	**15. NUMBER OF PAGES** 116
	16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT Unclassified	**18. SECURITY CLASSIFICATION OF THIS PAGE** Unclassified	**19. SECURITY CLASSIFICATION OF ABSTRACT** Unclassified	**20. LIMITATION OF ABSTRACT** UL

NSN 7540-01-280-5500

Standard Form 298 (Rev. 2-89)
Prescribed by ANSI Std. 239-18

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AN ASSESSMENT OF THE NATIONAL DUAL-USE POLICY AND ITS IMPACT ON THE PROGRAM OFFICE

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MASTER OF SCIENCE IN MANAGEMENT

from the

NAVAL POSTGRADUATE SCHOOL
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This thesis examines the current trends within the United States to move towards greater dependence on the commercial sector for military defense. Dual-use technologies impact the Defense acquisition process. It will discuss the risks associated with the migration of a defense industrial base to one of a national industrial base. Research will include conducting a thorough literature search, review of historical dual-use issues as well as defense and commercial initiatives in this area. Dual-use technologies can come in the form of CI or NDI. These items have the potential to save the program manager quite a bit of money, especially in the development costs. However, some would argue that these items might not be able to satisfy the peculiar environment required by the military. Others contend this to be the best method of procurement during this dwindling budget era. As DoD continues to rely on dual-use items, commercial sector initiatives gain momentum, particularly in the form of best practices. The program manager faces numerous challenges in employing dual-use technology.

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I. INTRODUCTION

A. PURPOSE

The purpose of this research is to analyze the current trends within the DoD to move towards greater dependence on the commercial sector for military Defense items. This thesis examines the current dual-use strategy for the United States. First, it will explore the historical context from which the term dual-use technology emanated. Then it will delve into what the current philosophy on dual-use technology is. Next it will analyze several key issues associated with dual-use technology. Finally, this thesis offers some conclusions and recommendations concerning these issues.

This research will also examine the potential of dual-use items in a possible acquisition strategy. The goal is to evaluate the risks and benefits associated with dual-use technologies and determine their usefulness for application in the Defense acquisition process. Dual-use technologies impact the Defense acquisition process. This thesis will discuss the risks associated with the migration of a Defense industrial base to a national industrial base.

This thesis includes a list of the research questions addressed and discusses the scope, the limitations and the assumptions made during the formulation of the thesis. Research will include conducting a thorough literature search, review of historical dual-use issues as well as Defense and commercial initiatives in this

area. This chapter includes a brief summary about the thesis methodology as well as the organization of the thesis.

B. BACKGROUND

The ending of the Cold War marked a significant change in the way the U.S. purchased items. It was the beginning of the end of "business as usual." The U.S. Defense industrial base has undergone some radical changes. Traditionally Defense contractors have merged or converted much of their capabilities toward the commercial sector. This phenomenon has given way to mandates to consider acquisition of dual-use technology.

Dual-use technologies can come in the form of commercial items (CI) or nondevelopmental items (NDI). Commercial items are those that have been sold to the general public. Nondevelopmental items are those previously developed items. These items have the potential to save the program manager quite a bit of money, especially in the development costs. However, some would argue that these items might not be able to perform satisfactorily in the peculiar environment required by the military. Others contend that maximizing dual-use technology is the best method of procurement during this dwindling budget era. As DoD continues to rely on dual-use items, the momentum increases to exploit the initiatives of the commercial sector. However, the program manager faces numerous challenges in employing dual-use technology.

A thorough analysis of dual-use technology would not be complete without an explanation of the role of technology transfer. During the Cold War, the U.S. Government led the commercial sector in technological developments. Many spin-off technologies were translated from their military role into a commercial use. In addition, technologies were transferred between nations. Of great concern is the potential leakage of critical military technologies into the hands of foreign governments. However, in efforts to maximize the budget, the DoD has to look to "spin-on" technologies and transfer the commercial technology to the military use. Some fear the further loss of U.S. technological superiority.

C. RESEARCH OBJECTIVES

The primary objective of this study is to provide an overview of the current trends within the United States to move towards greater dependence on the commercial sector for military Defense. Another objective is to determine the risks and benefits associated with dual-use technology as well as the migration of a Defense industrial base to one of a national industrial base. These insights can then be utilized to help program managers make decisions regarding the use of dual-use technologies within their acquisition strategy. These concepts can then be used in other major Defense acquisition programs to build upon the successes of program offices and maximize the effectiveness of acquisition reform initatives.

D. RESEARCH QUESTIONS

1. Primary Research Question

What is dual-use technology and how has it impacted program management?

2. Subsidiary Research Questions

- What is the application of dual-use technology? How does dual-use technology apply to program management?
- What is the relationship between the trend toward a national industrial base vice a Defense industrial base and dual-use technology?
- How do commercial items (CI) and non-developmental items (NDI) relate to dual-use technology?
- What are the significant differences in procuring these items?
- What is the impact of dual-use technology on the PMO and does it pose any significant problems for the program manager?
- What is the relationship between dual-use technologies and technology transfer?
- Could the U.S. Military lose its technological, competitive edge over its adversaries due to its dual-use initiatives?

E. SCOPE, LIMITATIONS AND ASSUMPTIONS

The scope will include: (1) a review of dual-use technology related documents, (2) an historical review of dual-use technology, (3) a review of current initiatives and practices in this arena, (4) a review of issues relating to specific dual-use technologies, specifically, (a) an analysis of the dual-use technology decisions made in a program office; (b) an analysis of dual-use employment

strategy; and (c) an analysis of the resources available to a Program Manager and his staff to employ dual-use technology.

F. METHODOLOGY

The basis for this research is current literature, regulations, acquisition documents, and interviews. Furthermore, the methodology used in this thesis research will consist of the following steps:

- A literature search of books, magazine articles, electronic database systems, and other library information resources.
- A review of dual-use technology and technology transfer related documents.
- Interviews with personnel from National and service level dual-use technology and technology transfer specific organizations.
- Site-visits to a program office that is either using, preparing to use or even considering using dual-use technologies in order to observe processes and considerations for their employment.
- An analysis of research results.

G. ORGANIZATION OF STUDY

Chapter I presents the introduction along with the basic research questions, the scope and method of research for this thesis.

Chapter II presents background information on dual-use technology. This chapter explains the historical context from which dual-use technology emanated during the Cold War.

Chapter III explains and examines the current trends in the Defense acquisition policy concerning dual-use technology.

Chapter IV analyzes the key dual-use technology issues as well as the lessons learned in applying these technologies in a program.

Chapter V addresses conclusions and recommendation on dual-use technology employment in the program office. It answers the research questions. This chapter further provides recommended areas for additional study.

H. CHAPTER SUMMARY AND CONCLUSION

This chapter has briefly introduced dual-use technology and its potential application in a program office. Furthermore, it has outlined the format of the thesis, the researcher's primary and secondary research questions, as well as the scope and objective of the study. It has also addressed the methodology and organization of the thesis. The next chapter provides a detailed explanation about the background of dual-use technology.

II. HISTORICAL PERSPECTIVE OF DUAL-USE TECHNOLOGY: THE TRANSFER "OUT" OF TECHNOLOGY

A. INTRODUCTION

This chapter discusses and defines dual-use technology in the old way of thinking. It reflects upon the history of dual-use technology in the era of the 1970s and 1980s, demonstrating the primary concern to the Program Manager as being the transfer "out" of technology. This chapter discusses how technology transfer occurs, causing the potential "leakage" of dual-use technologies. First, the background concerning technology transfer is laid out. Then, cooperative efforts are explained in detail. Finally, the chapter discusses how foreign military sales (FMS) fit into this potential transfer. All of these efforts relate to the denial of technology, a planned technology transfer, or the avoidance of an unplanned or inadvertent leak of a dual-use technology.

B. HISTORICAL BACKGROUND PERSPECTIVE OF DUAL-USE TECHNOLOGY TRANSFER

The term dual-use technology is used in several different ways. The first meaning for dual-use technologies arose during the Cold War. Essentially, dual-use technology generally applied to foreign nations admitting the use of, or requesting a technology for one purpose. However, that technology also had potentially other military or malicious implications. This was the most common understanding of the term dual-use technology as used in the intelligence

community. Prior to the fall of the former Soviet Union, dual-use technologies implied just that: peaceful technologies being used for a malicious end.

One example is nuclear technologies used for producing inexpensive electricity. The same technologies used in cyclotrons and particle separators are also used in the production of nuclear weapons. Another probably more familiar example includes the so-called "baby milk factories" of Iraq. Similar pasteurization-type devices can also be used for the production of biological agents. Figure 2-1 graphically portrays this comparison of dual-use technologies.

Traditional Dual-Use Technology

Technology	**Malicious Use**	**Peaceful Use**
Cyclotron & Particle Separators	Nuclear Weapons	Nuclear Power
Pasteurization Devices	Biological Agents	"Baby Milk"
Launch & Guidance Technologies	Missiles	Communications Satellites

Source: Researcher

Figure 2-1

Finally, many nations desire to take advantage of all the benefits associated with the use of satellites. They want to be able to employ satellites unilaterally, and not be dependent on other nations. However, the obvious peaceful use for these technologies is communication. The same technologies used for launching satellites also deliver Intercontinental Ballistic Missiles (ICBMs).

Another example of the denial of dual-use technologies includes protecting critical technologies. The intelligence community is ever vigilant of the nations belonging to the "*haves*" and "*have-nots*" associated with these technologies. The Missile Technologies Control Regime (MTCR) employs strict constraints on the exports of "missile technologies," closely monitoring their transactions. The U.S., along with the other member nations, meticulously monitors these transfers.

All the above examples pose legitimate, peaceful uses for the technologies desired by many nations. These processes and products described, having both civilian and military use, are considered *dual-use*. Ultimately, military and malicious uses of these dual-use technologies are of great concern to the U.S. Government. Particularly, concern for their unintended use or the inadvertent leakage/disclosure of a superior, leading-edge technology results in careful contemplation before technology release. This arena explains the "denial" aspect of dual-use technology.

During the Cold War, the Program Manager had to take great care in recommending what technologies had potential for unintended or malicious use.

He carefully planned his acquisition strategy to prevent the unintended use of his "technologies." Did the technologies have a "dual-use?" Could they be used in other methods than their intended purpose? Finally, were they a "critical" technology? During the Cold War, the PM mitigated these risks through avoidance. Tighter program and acquisition controls meant greater costs for the program, as some of the opportunities or benefits of cooperative efforts of foreign military sales were lost.

Historically, the definition of dual-use technology sounded like a simple concept. As stated earlier, it specifically pertained to foreign countries using U.S. friendly technologies for malicious ends. However, numerous issues surround the subject matter of dual-use technology emanating from a particular program. These issues include routine technology transfer as well as foreign military sales. These areas are of concern to the Program Manager and his staff, and deserve some explanation. Looking at technology transfer, and in particular FMS, reveals great insight into the historical approach to dual-use technology in a program. These areas constitute the "denial" aspect of dual-use technology.

C. TECHNOLOGY TRANSFER

1. Background

The intent of this section is to lay the foundation of technology transfer under the auspices of dual-use technology for application by a PM and his program office staff. It will explore the issues encompassing technology transfer. Later analysis will expound on some of its ramifications on the program office.

Simply stated, technology transfer is the spread of a technology that has already been developed and proven. Technology transfer can include anything from a manufacturing process to a new composite material. Although, this transfer may or may not include dual-use technologies, the technology transfer applications in this thesis specifically pertain to dual-use technologies.

Technology transfer has both a "denial" facet and also a "use" aspect (which will be discussed in detail in a later chapter). So why is technology transfer so important to a Program Manager? The "denial" aspects of dual-use technology caution the Program Manager from leaking critical technologies. Yet, Chapter III will demonstrate that the "use" side of technology transfer can provide valuable benefits. The Program Manager needs to understand how technology transfer fits into his program. As stated earlier, there are several nuances of technology transfer that may be helpful to the Program Manager when he is deciding to employ technology transfer in his acquisition strategy, and if so, how to use it.

The "denial" facet of the technology transfer aspect of dual-use technology concerns itself with that technology transferred out from a program. Of concern to the PM is his program being the purveyor of technology. Essentially, he defines the critical technologies that are not to be leaked outside his organization. The Defense Institute for Security Assistance Management (DISAM) provides a list of technology transfer methods (Meuschke, 1996):

- Commercial and Government Sales
- Scientist, Engineer, Student, and Academic Exchanges
- Consulting Agreements
- Licensing and other Data Exchange Agreements
- Co-development and Co-production Agreements
- Trade Fairs, Exhibits, and Air shows
- Sales to Third Party Nations
- Multinational Corporation Transfers
- International Meetings and Symposia on Advanced Technology
- Clandestine or Illegal Acquisition of Military or Dual-use Technology or Equipment
- Dissemination of Technical Reports under DoDD 5400.7, *Freedom of Information Act Program*
- Dummy Corporations
- Acquiring an Interest in U.S. Industry, Business, and other organizations

Since dual-use technologies creep-up in all of these areas, one must ask the gnawing question: So, how do these concerns about dual-use technology impact a PM and his staff? Preventing others from access to a particular technology becomes paramount in an acquisition strategy. Although he must remain wary of all of the above with respect to the denial aspect of dual-use technology, the PM has two primary concerns specifically pertaining to the production and quality of his program. Understanding these concerns explains how the technologies can be transferred.

The actual transfer of technology may occur during *cooperative efforts* or during foreign military sales (FMS). On the surface, both provide advantages to the PM. In a cooperative effort, the program office saves by not having to bear the burden of the entire cost of program development. In addition, FMS can also help spread the costs of production over a greater yield. Either of these methods can provide numerous benefits to the PM. However, the PM must be conscious of the technology transfer ramifications in order to avoid inadvertent disclosure of sensitive or classified materials.

2. Cooperative Efforts

Cooperative efforts between the U.S. and other countries provide many benefits for the PM. Life-cycle cost reductions, quality improvements, delivery enhancements, dual-sourcing, providing for surge requirement, if needed, and an overall reduction in risk are some of the potential benefits of a cooperative

program. (Mueschke, 1996) However, the program office must provide early and meticulous planning to ensure a smooth transfer of technology during the cooperative effort. Furthermore, the type of technology will generally determine how the program office transfers the technology.

Transfer methods provide the venue for technology transfer of dual-use technology. Generally, international technology transfer may occur in three different manners: Contractor-to-Contractor; Contractor-to-Government; or Government-to-Government (Matthews, 1997). These transfer methods are ordered based on their increasing level of technology (state-of-the-art), and deserve further analysis as they pertain to cooperative efforts.

First, *Contractor-to-Contractor* transfer is one where the contractor has the greatest level of autonomy with very little Governmental oversight. This method allows contractors to develop working relationships in related fields. Next, a *Contractor-to-Government* transfer has increased Governmental oversight. More agencies become involved, and therefore communication problems increase. Finally, a *Government-to-Government* transfer involves the greatest level of Governmental oversight and is used primarily for major weapon system transfers.

In each of the three methods of international technology transfer, as well as in domestic technology transfer, three transfer mechanisms exist: Direct Licensing; Contractor Teaming; and Leader-Follower. All of these mechanisms deserve an explanation. First, *Direct Licensing* is basically the selling of

technology, usually involving patents and payments of royalties. An organization can use direct licensing to obtain dual-sourcing. *Contractor Teaming* is the shared development and ownership of a technology, allowing for design specialization. Contractor teaming is a direct transfer from contractor to contractor. Finally, the *Leader-Follower* transfer mechanism is a relatively fast method best used for complex systems. It involves one contractor as the primary developer with another contractor that follows suit.

3. Foreign Military Sales (FMS)

Another issue surrounding the transfer of dual-use technology out of a program involves foreign military sales, as discussed briefly earlier. FMS can provide amazing benefits to not only the program office but to the entire U.S. industrial base as well. According to the introductory studies of *Systems Acquisition and Program Management,* there are several basic reasons for FMS (Matthews, 1997):

- Promote U.S. Security by Arming Allies with interoperable Equipment
- Keep U.S. Production Base "Warm"
- Reduce U.S. Procurement Unit Costs
- Help U.S. Economy and Balance of Trade
- "Influence, Influence, Influence"

The United States has been rather successful in FMS endeavors. Recently, the United States has provided as much as 70 percent of the worldwide weapons

market (Beard, 1995). Although the perceived imbalance is a very contentious issue in the international political arena, the PM generally needs to focus on how FMS can benefit his production. However, he must struggle with the implications of leaking critical technologies or selling technologies to be used for unintended purposes.

Recent headlines in *Defense News* proclaimed that the U.S. Government is going to "overhaul" its official FMS program as it continues to dissatisfy current and potential purchasing nations. Although bureaucratic systems often have room for improvement, the FMS program has been successful for many years, as stated earlier. The same article presents FMS receipts in 1997 at $8.8 billion (U.S.), albeit considerably lower than the "$33 billion in 1993 contracts that were signed in the aftermath of the 1991 Persian Gulf War." Such numbers would be expected considering the international environment at that time.

Still, overhauled FMS or not, a Program Manager and his staff must still consider the dual-use implications of FMS on their program. Yet, FMS are not quite as simple as producing additional items to sell to a foreign country. The Program Manager is suddenly confronted with imbedded issues ranging from technology transfer of dual-use technologies to the incredible interdependence of the global economy. Combined, these issues add an additional layer of responsibility on the already over-burdened program office staff.

An effective Program Manager who undertakes foreign military sales during the life cycle of his program may secure tremendous gains in his program overall, similar to that of technology transfer. However, as stated earlier, foreign military sales need to be better understood by the PM. Why would a PM even bother with the difficulties associated with FMS?

As the Defense budget continues to dwindle, so too will the procurement quantities. In addition, the fall of the former Soviet Union has led to a glut of state-of-the-art weaponry for sale. These factors have combined to push forward the sale of modern U.S. weapons to foreign countries, since the U.S. will sell technology that they would otherwise be reluctant to sell. Basically, the U.S. needed to decide to stay competitive in FMS by making some of U.S. state-of-the-art weapons for sale. In addition, FMS customers may like U.S. equipment because it seemed to work well in Southwest Asia and because they know they can obtain decent logistical support. Thus, shrinking Defense dollars have resulted in attractive FMS opportunities to international customers. This has also proved beneficial to the PM whose funds may have been reduced. That PM can now buy more weapons at a cheaper unit cost due to the overall increase in procurement from foreign sales. Furthermore, if a PM's production dollars dry-up one year, the contractor's factory might continue to produce for foreign customers, keeping alive the U.S. Defense industrial base. When that PM receives his production money, he can then benefit from the already producing "warm" factory as well as sharing

the benefits of the learning curve. Ideally, the contractor will be able to make the product faster and better than the last batch of systems.

The benefits of FMS do not come to the PM without a price. The price to the PM is in understanding the complex export system for military items. Some of the players involved in FMS include the following:

- The President
- National Security Council
- Congress
- Department of State
- Department of Commerce
- Department of Defense
- Office of Management and Budget

The PM can never underestimate the power of domestic and international politics on FMS, as well as organizational and cultural dynamics. Thus, in addition to the complex opinions on the definitions of critical technologies, the PM has to remain on schedule working within the confines of such an unwieldy bureaucracy.

D. CHAPTER SUMMARY

The primary concern about dual-use technologies for Program Managers before Acquisition Reform was that of denying certain technologies to foreign entities. Critical technologies were held close and the dual-use aspect came about

when friendly or peaceful technologies were used for unintended military or malicious purposes. The transfer of technology during cooperative efforts as well as FMS demonstrates the "denial" of dual-use technologies. This imperative throughout any program was significant during the Cold War.

This chapter explained dual-use technology and its role in the program office before Acquisition Reform. The transfer of technology emanating from a program office came about generally through cooperative efforts or foreign military sales. This chapter explained how Program Managers considered dual-use technologies in each of these areas. Thus, the desired result of PM analysis of dual-use technologies was to deny the release of sensitive technology. Through these channels, the PM could also plan a transfer of non-critical technology, as well as avoid the risks of an unplanned or inadvertent leak of a critical, dual-use technology. The next chapter details the current ideas concerning dual-use technology and the Acquisition Reform movement toward the "use" aspects of dual-use technologies.

III. THE "USE" ASPECTS OF DUAL-USE TECHNOLOGY

A. INTRODUCTION

This chapter defines and discusses the current trend in the technology transfer of dual-use technology. In other words, the "use" aspects of dual-use technology imply how a program manager (PM) can use dual-use technologies to meet his acquisition strategy. It also discusses some of the documents and legislation concerning the political atmosphere of dual-use technology in light of today's reduced budget era. Additionally, it discusses several courses of action that will help the program manager to decide on employment of dual-use technology. It also reviews applications of dual-use technology as well as a current program involving dual-use technology. Finally, this chapter discusses how commercial and nondevelopmental items fit into dual-use technology.

B. CURRENT TRENDS

The current trend in technology transfer in dual-use technologies involves the transfer of technology into a program from the civilian application. Receiving technology generally has positive aspects for a PM. However, ten years ago, research would primarily divulge concerns only about international technology transfer. Currently, in the United States Government and academia, research indicates a growing slant towards sharing this knowledge base. Executive Order (EO) 12591 mandates technology transfer (Appendix A). While addressing the issue of international transfers, EO 12591 emphatically pursues the concept of

domestic technology transfer between Federal, state and local governments, universities, and the private sector, to include both Defense industries and small businesses as well (DTIC, 1997). A greater cooperative effort will result in lower costs for DoD and a stronger national Defense industrial base.

This current trend is predicated on the "use" aspect of technology transfer, or rather, dual-use technologies.[1] Dual-use technologies manifest themselves in technology transfer as the Department of Defense (DoD) further encourages cooperative technological efforts. According to Doctor Perry's June 1995 memorandum (Appendix B), that message is clear about technology. DoD's acquisition programs must recognize the current technologies of the national industrial base. When new technologies are developed, they should be dual-use technologies (DTIC, 1997). Note here that historically when we think of *technology*, our minds think of items like circuit boards and such. Technology however, may also be processes, software, and intellectual property, as well. Any and all of these technologies may be beneficial to the PM.

The executive branch is not alone in embracing technology transfer as a beneficial process. The Congress demonstrates an understanding of technology transfer too. Albeit, this is their current position on technology transfers, it has evolved over time. Chart 1 briefly outlines the legislation involving technology

[1] The term technology transfer often implies dual-use technology according to the framework of this thesis.

transfer as it is portrayed in the dual-use umbrella (DTIC, 1997). (See Appendix C for further details.)

Chart 1
Technology Transfer Legislative History

- Stevenson-Wydler Technology Innovation Act of 1980 (PL 96-480)[15 USC 3701-3714]
- Bayh-Dole Act of 1980 (PL 96-517)
- Small Business Innovation Development Act of 1982 (PL 97-219)
- Cooperative Research Act of 1984 (PL 98-462)
- Trademark Clarification Act of 1984 (PL 98-620)
- Japanese Technical Literature Act of 1986 (PL 99-382)
- Federal Technology Transfer Act of 1986 (PL 99-502)
- Malcom Baldrige National Quality Improvement Act of 1987 (PL 100-107)
- Executive Orders 12591 and 12618 (1987): Facilitating Access to Science and Technology
- Omnibus Trade and Competitiveness Act of 1988 (PL 100-418)
- National Institute of Standards and Technology Authorization Act for FY 1989 (PL 100-519)
- Water Resources Development Act of 1988 (PL 100-676)
- National Competitiveness Technology Transfer Act of 1989 (PL 101-189) (included as Section 3131 et seq. of DoD Authorization Act for FY 1990)
- Defense Authorization Act for FY1991 (PL 101-510)
- Intermodal Surface Transportation Efficiency Act of 1991 (PL 102-240)
- American Preeminence Act 1991 (PL 102-245)
- Small Business Technology Transfer (STTR) Program 1992 (PL 102-564)

- National Department of Defense Authorization Act for 1993 (PL 102-25)
- National Department of Defense Authorization Act for FY 1993 (PL 102-484)
- National Department of Defense Authorization Act for 1994 (PL 103-160)
- National Technology Transfer and Advancement Act of 1995 (PL 104-113) [also known as the "Morella Act"]

This brief legislative history emphasizes two underlying aspects of technology transfer. First, technology transfer is not a new concept. Congress passed The Stevenson-Wydler Technology Innovation Act of 1980 almost 20 years ago. Second, current legislation continues to revitalize and expand dual-use technology programs, specifically technology transfer programs. In addition, a plethora of information on policy memorandums exists. A quick search of the DoD and other Federal Internet sites reveals more dual-use technology information than one could conceivable digest coherently at one sitting. Thus, Congress is very active in dual-use technology based on the amount of laws and reports generated by them.

There are clearly some DoD technologies that were commercialized, resulting in benefits for both the commercial sector as well as DoD. These dual-use technologies are generally categorized as "spin-off" technologies. See Chart 2 for some examples of these technologies (NEC, 1995).

Chart 2
Benefits of Commercializing DoD Technologies

Many TRP projects "spin off" Defense technologies to strengthen important Defense producers and lower the cost to the military.

DOD TECHNOLOGY	COMMERCIAL BENEFITS	DEFENSE BENEFITS
Uncooled infrared sensors	Night driving assistance Security surveillance Collision avoidance systems Locating power and thermal leaks	Order of magnitude lower cost for night vision technology
Integrated millimeter wave radar/ infrared sensor for landing guidance system	Airline safety during inclement weather	Enables military use of poor landing strips for combat support
Lasers	Laser machining (improved precision in cutting and welding, less machining required)	Improved low-rate production of military systems (e.g., military aircraft, ship, vehicle production). Lasers for "blinding" sensors of incoming missiles
Acoustic signal processing and diagnostics	Just-in-time maintenance on shafts, power generation systems (turbines, generators)	Replacement of critical helicopter rotor components prior to failure
Enhanced Position Location Reporting System	Advanced automatic train controls	40% cost reduction in battlefield location system
Fly-by-light	Alternative to fly-by-wire	Invulnerability to electromagnetic pulse, RF interference
Pyrotechnics	Rescue equipment	Preserve on-shore Defense industry
Amorphous silicon technology	Medical imaging	Battlefield casualty diagnostics, teleradiometry
Nuclear submarine valve technology	Zero emission control valves (e.g., refineries, chemical transport)	Reduce cost, preserve supplier
Advanced polymer composites	Bridge, infrastructure repair	Availability, affordability for high performance advanced composites; portable tactical bridges

Similarly, there have been quite a few commercial technologies leveraged specifically for the benefit of DoD. These "spin-on" technologies are of great interest to the program manager for obvious reasons. Chart 3 enumerates several of these technologies (NEC, 1995).

Chart 3
Leveraging Commercial Technologies for Defense

TRP "spin-on' projects provide the DoD with superior technology that will be sustained by dynamic commercial markets.

COMMERCIAL TECHNOLOGIES	DEFENSE BENEFITS
Electric and hybrid propulsion (e.g., turboalternators, propulsion systems)	Enabling technology for armored, tactical vehicles (acceleration, rough terrain capability, on-board power, silent running, fuel efficiency, design flexibility)
Advanced batteries	Reduce logistical burden from increased demand for portable electric power on battlefield
Healthcare technologies (digital X-Rays, telemedicine, noninvasive organ sensors/diagnostics, oxygen generator, biological modeling)	Trauma care under battlefield conditions to save lives through intervention during "golden hour"; virtual physician presence; measurement/transmission of vital signs
C41 (self healing networks, voice recognition systems, spatial division multiple access technology)	Affordable, updateable, high bandwidth, wireless networks to serve highly mobile stations
Nuclear, biological and chemical detection (infrared and ultraviolet sensors; mass spectrometry; chemical ar biological agent sampling, collection, and : .apping)	Accurate detection and remote monitoring for chemical and biological agents
Electronics design and manufacturing (optoelectronics, low-cost packaging)	Ability to integrate optical information into electronics systems; affordability through adopting commercial, low-cost electronic packaging techniques
Ultrasonics	Ability to determine aircraft wing icing potential prior to takeoff; particularly applicable to secondary airfields

Since the trend in acquisition reform today is to embrace dual-use technology application, it is imperative to demonstrate to the program office exactly why it is so important. An effective program office employing robust technology transfer constraints throughout the life cycle of the program may garner enormous benefits in the program. Understanding technology transfer and its related issues provides a great deal of insight into successful employment of dual-use technologies and strategies to counter some potential drawbacks. However, the concepts surrounding dual-use technology transfer are not as clear-cut as one may think.

C. DUAL-USE TECHNOLOGY "USE" IN A PROGRAM

As alluded to in Chapter II, the main concern for Program Managers concerning dual-use technology is how they can take advantage of existing, leading-edge technology. Several trends exist in today's world that will help the PM decide which path to choose. First, the increasing partnership between government and industry broadens a commercial sector helping the Defense industry. Second, the particular contractors involved, especially the prime contractor, may provide valuable insight, too. Third, combined efforts between DoD and industry demonstrate future willingness by industry to partner with DoD.

The international treaty implications of technology transfer and dual-use technologies are far reaching, as too are the political ramifications at the governmental level. However, what does deserve more analysis is the civilian

uses of military items and military use of civilian items. Thus, these applications foster the advancement of dual-use technology employment. It is here where the PM can directly influence those issues that promptly affect him. An extension of this issue is the implication for the Defense industrial base.

An earlier section revealed the sentiment of the Administration and the Secretary of Defense, as well as the Legislature. It is clear that the political atmosphere supports the dual-use agenda. With acquisition reform and massive commercial sector mergers in the Defense industry further affecting the program office's daily activities, one question comes to mind. Does the U.S. still require a Defense industrial base? Although a full and complete answer is well beyond the scope of this thesis, this issue deserves some discussion.

The co-production of military and commercial items sounds very appealing in this acquisition era. This, in fact, may strengthen the U.S. Defense industrial base. In the past, the DoD pushed technology in many areas, leading in the research and development area. In this time of constrained budgets, the DoD has to rely on the civilian sector to push the technological envelope. A collaborative effort between the commercial sector and the DoD may be very beneficial to both parties, and it is the logical next step in partnering. This arrangement gives DoD access to leading-edge technology in the commercial sector. Also the DoD obtains more affordable prices as the combined military and commercial demand for products and process dri[illegible]wn prices. Furthermore, the industrial base will

then also be prepared for the time when military situations dictate increased production during wartime scenarios.

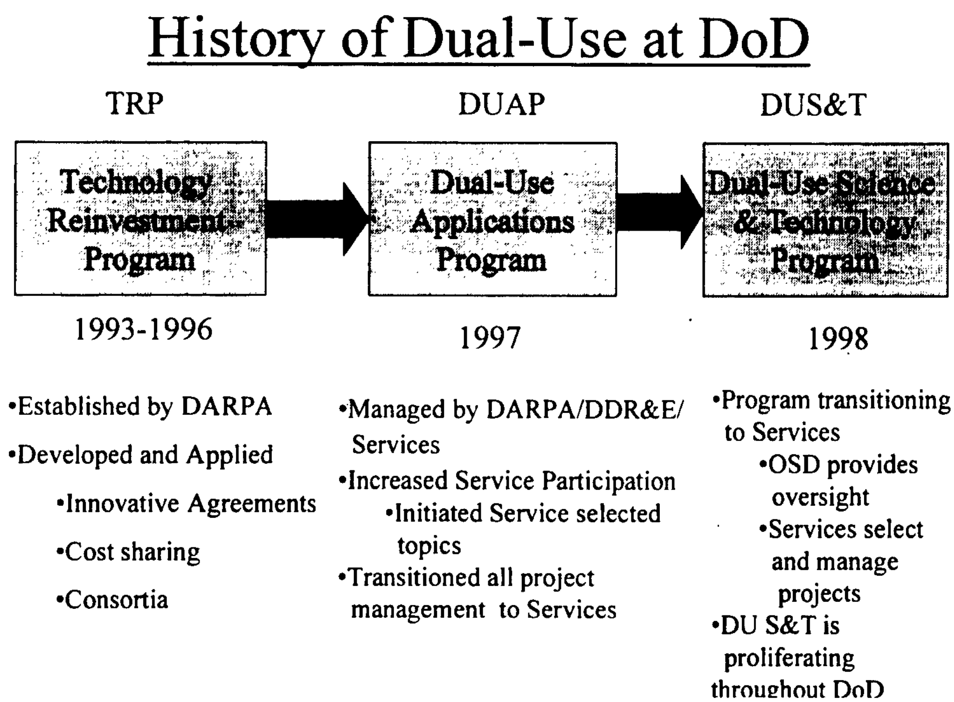
One such cooperative effort was the Technology Reinvestment Program started in 1993. Federal money existed for those program offices willing to venture into dual-use technologies through this program. One example from this program included the widespread use of infrared sensors made ten times cheaper by leveraging new commercial technologies. Another example involved the computer industry, where vast increases in portable low-cost data storage can give front line soldiers immediate access to the best information and intelligence. Finally, the most notable dual-use technology developed from the Technology Reinvestment Program involved battlefield casualty treatment whereby new sensors and information systems greatly improve the ability to find, diagnose and treat injured combatants during the first hour they are down in the field.[2]

The commercial sector, too, has proven successful in deploying once specifically military technologies into civilian use. The FOREWARN® radar system used by Delco in fighter aircraft has been successfully inserted into school buses. This radar, adapted and made obviously less expensive, assists the driver in verifying that the traditional blind spot is free of school children. (For school buses that is the spot immediately in front of the hood for approximately four to

[2] These examples are compiled from numerous web sites involving both dual-use technologies programs as well as the specific items researched. One site is *www.acq.osd.mil/es/dut/dufinal8.html.*

five feet.) Leveraging the uses for this technology suggested the idea for automobile makers to adapt it for the passenger car. The automobile industry plans to test out this radar integrated into their cruise control mechanism to prevent cars from hitting vehicles in their blind spot. Marketed by Delco Electronics Systems, FOREWARN® Forward Looking System, Side Detection System, and Back-Up Aid System all assist cars in this endeavor.[3]

Over time, the TRP has developed into the Dual Use Science and Technology Program (DU S&T, 1998). (See Figure 3-1)



Source: DU S&T, 1998

Figure 3-1

[3] This general information was extracted from Delco's website at *www.delphianto.com/delco/Forewarn.*

According to Dr. Jacques Gansler, the Under Secretary of Defense for Acquisition and Technology, "The maintenance of our technological superiority on future battlefields will depend on our ability to take advantage of technological advances occurring in commercial industry. In response, the Department has established the Dual Use S&T Program to fund and develop technologies that will prove a military advantage on the battlefield and meet the demands of the commercial marketplace."

The Dual Use Science and Technology Program leverages the costs of technology development with industry to reduce cost and increase performance and sustainability of Defense systems. In addition, it promotes the culture of dual-use within the Services in order to satisfy the materiel needs of the future. All of the projects emanating from this program are to jointly develop these technologies based on funding shared by the DoD and industry. In order to attract the non-traditional industry contractors and take advantage of their valuable insight, many of the FAR requirements are waived to add flexibility and efficiency. Of course since these are dual-use technologies, they are developed with the intent to meet both Defense and commercial industry needs. In addition, as research dollars shrink for both the DoD and industry, these scarce dollars can be leveraged more effectively (DU S&T, 1998).

Some specific technological subjects lend themselves to a greater extent to the dual-use arena. Thus, the DUS&T Program has particular focus areas to maximize this commonality. These areas include the following:

- Affordable Sensors
- Aircraft Sustainment
- Distributed Mission Training
- Fuel Efficiency & Advanced Propulsion
- Information Systems & Technology
- Medical Technologies
- Advanced High Speed Vessels and Structural Systems for Large Sea-Based Structures
- Environmental Monitoring

The following minimum requirements exist to ensure the adequacy of the mutually beneficial partnership. Obviously, in order to get industry to provide their 50% of the cost share, the technology must not only meet military needs, but it must also be commercially useful. Contract awards must be based upon full and open competition.

The vision of the Dual Use Science and Technology Program staff, according to Dan Petinito, the Program manager, is to have a plethora of technologies readily available. Program managers can then converge on a central organization to acquire material solutions for their needs. The critical concept of

this program is that a wide range of technologies must be developed to meet future needs. There is not a focus on the application.

The technology program encourages mutually beneficial partnership between the DoD and industry. The first two Dual Use Science and Technology Program solicitations have resulted in over $500 million invested by the DoD and industry (DU S&T, 1998). Based on the interest shown by industry participants of the *Industry Days* conference held in Los Angeles in October 1998, the program staff expects many proposals to be submitted prior to the December deadline.

D. COMMERCIAL AND NONDEVELOPMENTAL ITEMS (CI & NDI)

Based on past ideas as a foundation for Acquisition Reform, a number of strategies and control methods either came into being or were strengthened to make the acquisition process more efficient. Examples of the strategies include Evolutionary Acquisition (EA), NDI Acquisition, integrated product and process development, and acquisition of commercial items on commercial terms. This section will specifically focus on the concepts surrounding use of commercial items and NDI in an acquisition strategy.

According to the Defense Acquisition Deskbook (DAD), commercial items are any items, other than real property, that are customarily used for non-governmental purposes and:

(1) have been sold, leased, or licensed to the general public; or

(2) have been offered for sale, lease or license to the general public; or any item that evolved through advances in technology or performance and that is not yet available in the commercial marketplace, but will be available in the commercial marketplace in time to satisfy the delivery requirements under a Government solicitation (DoD, 1998).

This definition also includes the services in support of a commercial item, or those services offered in substantial quantities, competitively in the commercial marketplace based on established catalog or market prices. Modified commercial items include both commercial items commonly modified in the commercial marketplace or those with minor modifications of a type not normally available in the commercial sector in order to meet Government specifications (DoD, 1998).

Commercial items are often confused with NDI. Albeit similar, the Federal Acquisition Regulation, (FAR), makes a clear distinction between commercial items and NDI. Initially, commercial items were considered a subset of NDI (DoD, 1998). However, increased desires to field affordable, state-of-the-art systems, while emphasizing efficient use of the scarce financial resources of DoD resulted in clear delineation between the two approaches. A brief explanation establishing the foundation of the terms presents an excellent starting point before discussing the issues associated with dual-use technologies. Figure 3-2 graphically outlines the basic concepts of both Commercial items and NDI.

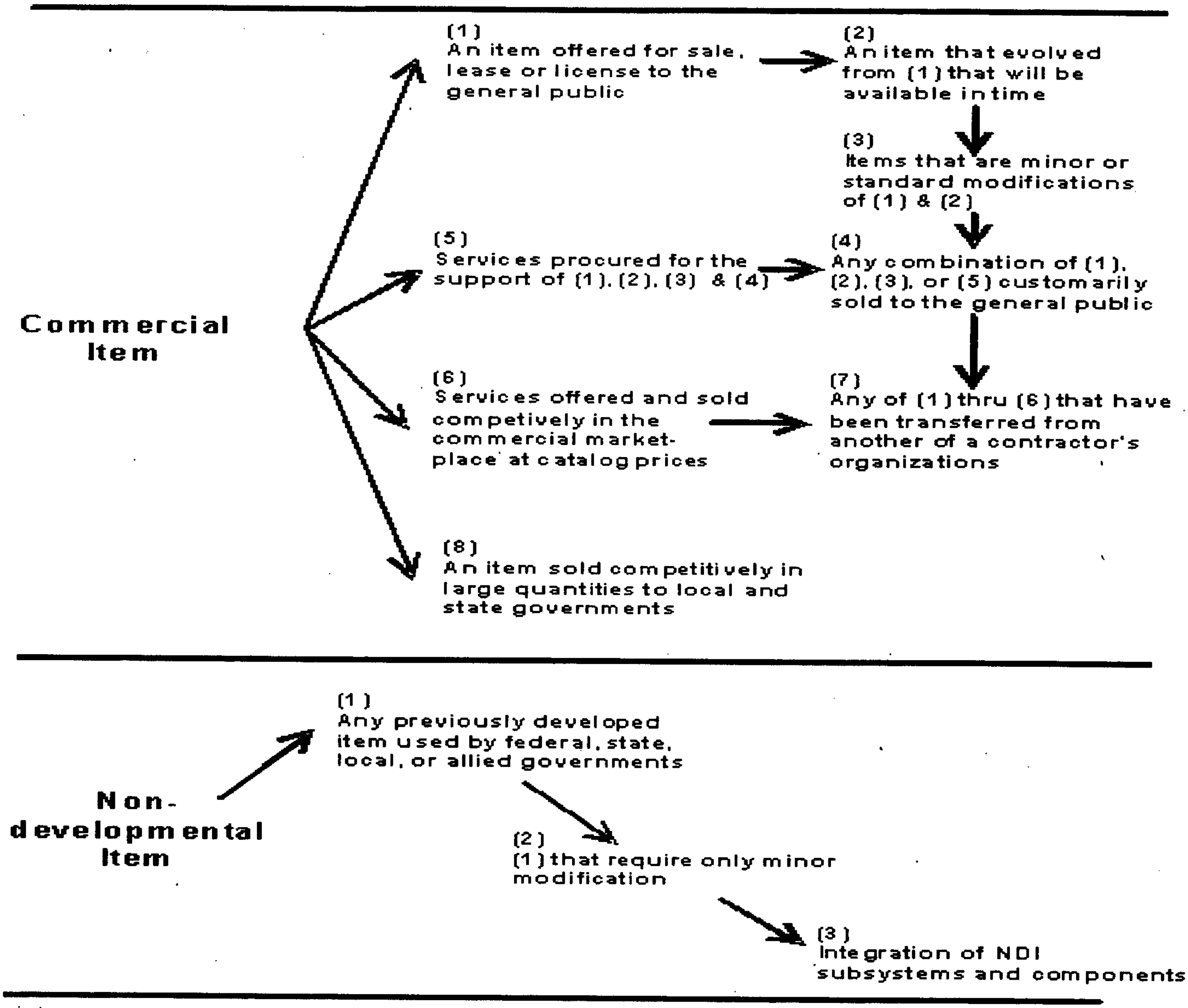


Figure 3-2. ***Commercial Item and Nondevelopmental Item Summary*, (DoD, 1998)**

The definition of an NDI is much simpler. A nondevelopmental item is any previously developed item of supply used exclusively for government purposes by a Federal agency, a state or local government, or a foreign government with which the United States has a mutual Defense cooperation agreement. Also NDI includes any item described above that requires only minor modifications or

modifications of the type customarily available in the commercial marketplace in order to meet the requirements of the processing department or agency (OUSD (A&T), 1996). Both commercial and nondevelopmental items may both offer technology transfers. Therefore, the question to a program manager becomes can or should he use dual-use (either CI or NDI) technologies in his program?

E. CHAPTER SUMMARY

This chapter presented the current trends in dual-use technology today. It demonstrated the commitment by government and political organizations. It also depicted how the Technology Reinvestment Program has developed into a new application of the DoD dual-use technology effort called the Dual Use Science and Technology Program. Finally, it explained the role of commercial and nondevelopmental items within the context of the dual-use technology arena. The next chapter will present the analysis of this thesis.

IV. DUAL-USE TECHNOLOGY ANALYSIS

A. INTRODUCTION

The past two chapters of this thesis described the historical context from which dual-use technology emerged. They also described the current inclination in DoD today concerning dual-use technology. This chapter discusses key dual-use technology issues, including the PM's decision to employ dual-use technology. Next it details how PMs go about employing dual-use technology. It then adds an analysis of resources available to PMs and their staff, assisting them in dual-use technology considerations. Finally, this chapter closes with a look at the Army Sniper Rifle case.

B. KEY DUAL-USE TECHNOLOGY ISSUES

1. The Decision to Employ Dual-Use Technology

Throughout history, technology has changed warfare. The rifled barrel demonstrated to Napoleon that the tight-knit phalanx would no longer be an effective battle formation for the infantry. The rifling gave guns a much greater range and accuracy, and formations of infantry could be picked-off before they lifted their own weapons to fight. The tank broke the stalemate of trench-warfare during World War I. Time and time again, technology impacted warfare. Even the massive deployment to the Persian Gulf in 1990 heralded some technologies

impacting the outcome of the war. For example, some argue that the Allied Coalition, principally the United States, owned the night. The U.S. Forces equipped with night vision devices inflicted severe casualties on Iraqi forces in night battles during the Persian Gulf War. Successful employment of technological advantages swayed the outcome in favor of the Coalition Forces. New technologies will continue to play a major role in future warfare.

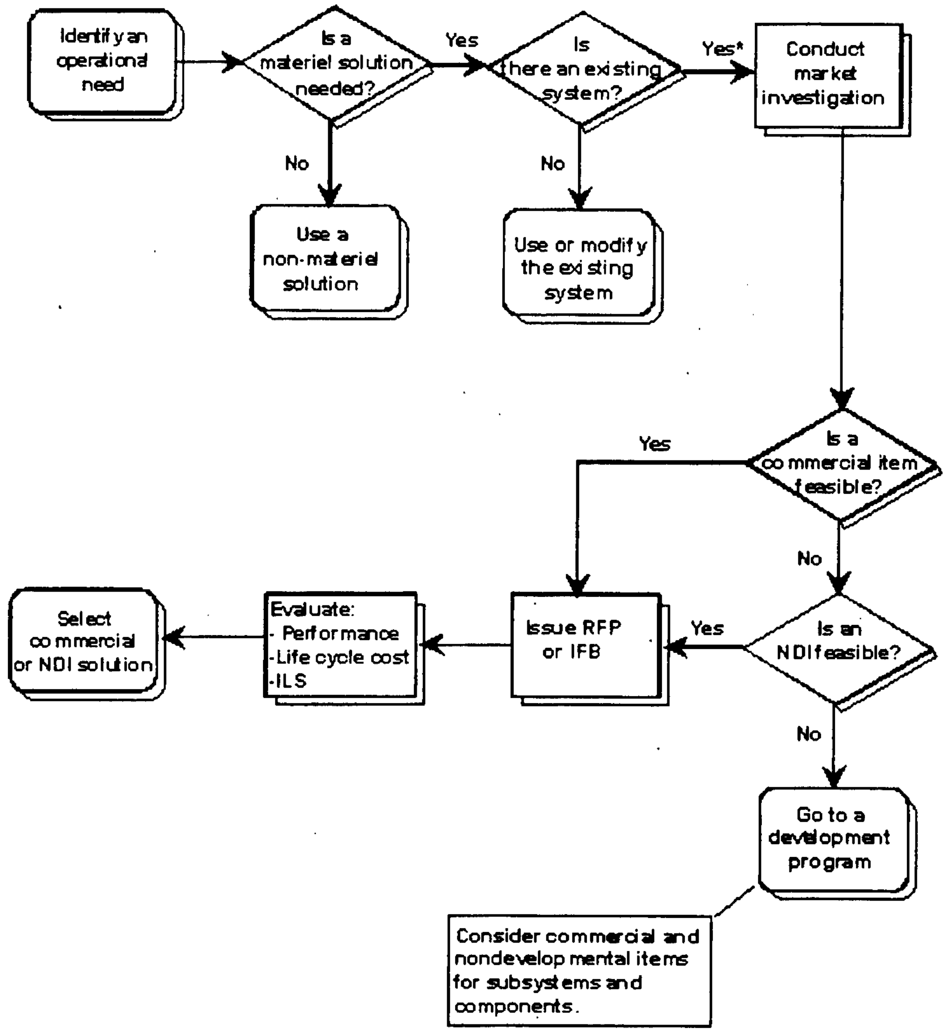
State, local and civilian organizations have traditionally looked for military technologies that could be adapted for civilian use, that is, spin-off technologies. Spin-off technology transfer has often been acceptable, and Chapter III demonstrates that it is now officially encouraged from not only the Executive Branch, but also the Legislative Branch as well. In reverse, the PM must be concerned whether what is available commercially can be readily used or adapted to his program. With the current wave of Acquisition Reform and budget constraints, dual-use commercial technologies may offer relief to funds-starved acquisition programs. As alluded to earlier, these dual-use technologies are a major factor in technology transfer. Adapting dual-use commercial products may save the program research and development costs and at the same time provide advanced technology otherwise unavailable for warfighting systems. Thus, the PM offices must be knowledgeable of the potential military uses of civilian

technologies. Defense acquisition will continue to depend on the civilian sector for processes and products.

The above explanation cannot stand-alone. As stated earlier, it is the leading edge technologies that are the decisive factors in war. If the United States never pushed technology forward, the National Defense would become stagnant, while other countries developed a decisive edge. This sounds like double talk to a PM. So where does this apparent dichotomy of priorities leave the PM? Actually, it is a balancing act for the PM. He must stay aware of the current technological trends in warfighting systems and associated processes relevant to his program. He may decide to use that commercial or NDI technology. Then again, he may decide the cost does not have a sufficient benefit. Thus, he must initiate a full-scale development program. Figure 4-1 explains that even in these situations, a PM should consider dual-use technologies for sub-systems or components.

For example, a current trend in making automobile parts is foam casting. The new *Saturn* Corporation developed a technique designed to create very durable and long lasting car body parts, such as fenders via foam casting. A conscientious PM in the business of making vehicles should consider this technology. He ought to consider the life-cycle costs of foam casting specifically to his program. Set-up costs are more expensive to initiate, but may provide costs

savings over the entire production run or during the operation and support of the vehicle. In this case, a careful cost-benefit analysis is necessary.



* In preparation for the market investigation establish objectives and thresholds for cost, schedule, and performance based on the users' operational and readiness requirements.

Figure 4-1. ***The Commercial/NDI Decision-Making Process*****, (DoD, 1998)**

The above hypothetical example may have helped demonstrate a portion of the PM's balancing act. Should he use a state-of the-art technology from the commercial sector? Should he develop a new process for this requirement? Or does the old process adequately meet the requirement's needs? Remember that this is not the only source of available technology to transfer. A quick search on the Internet will reveal many clearinghouses for technology transfers from government, commercial and academic sources. Not to mention there are numerous topical publications on various technologies and processes in the manufacturing arena as well. The research and development area also has various clearinghouses for shared developments and ideas. The PM balances whether he should employ an existing technology from one of the above sources or use one with which he and his contractor are familiar. Furthermore, he needs to decide if he needs to push technology forward and develop new cutting-edge technology.

Why should a PM consider technology transfer in his program and what are the issues of concern for him? Using tested and proven technologies, a Program Manager can increase the quality and productivity of his program. The Program Manager needs to understand technology transfer beyond the scope of a simple definition such as the one above, as well as the relative importance of technology.

Programs such as the Dual Use Science and Technology (DU S&T) Program described in Chapter III help encourage as well as entice both industry

and the Services to get into the business of dual-use technologies. Thinking about dual-use technologies during the research and development assist in the goals of the Program Managers in the long term. Dan Petonito, the PM for the DU S&T Program explained that his strategic vision for the program was that it must be a clearinghouse or store of dual-use technologies from which a PM could browse and shop to find the technology, the dual-use technology, to meet his need (Petonito, 1998). The realistic vision for the next millennium would be a virtual store in which both shoppers, the PMs, as well as the sellers, (industry) could electronically browse. PMs could interject the current and future needs, while industry marketers could gage the next generation of technology.

Using dual-use technologies will help broaden the national industrial base in two ways. First, the desire to use commercial and nondevelopmental items will encourage those contractors who exist solely to meet Defense related needs to expand their production into the commercial sector. Second, as we look to NDI solutions, we look to a greater spectrum of industrial solutions and are not limited to the strict military contractors. Thus, two benefits to the practice of looking to CI/NDI for material solutions may be seen. Furthermore, this will become ever so important, as Figure 4-2 suggests that all new needs or requirements of the DoD will be met with some degree of commercial item or NDI. CI/NDI use will not be a binary gate, yes or no. Rather, the program manager in conjunction with the

contracting officer will be able to tailor the program to best utilize the available CI/NDI.

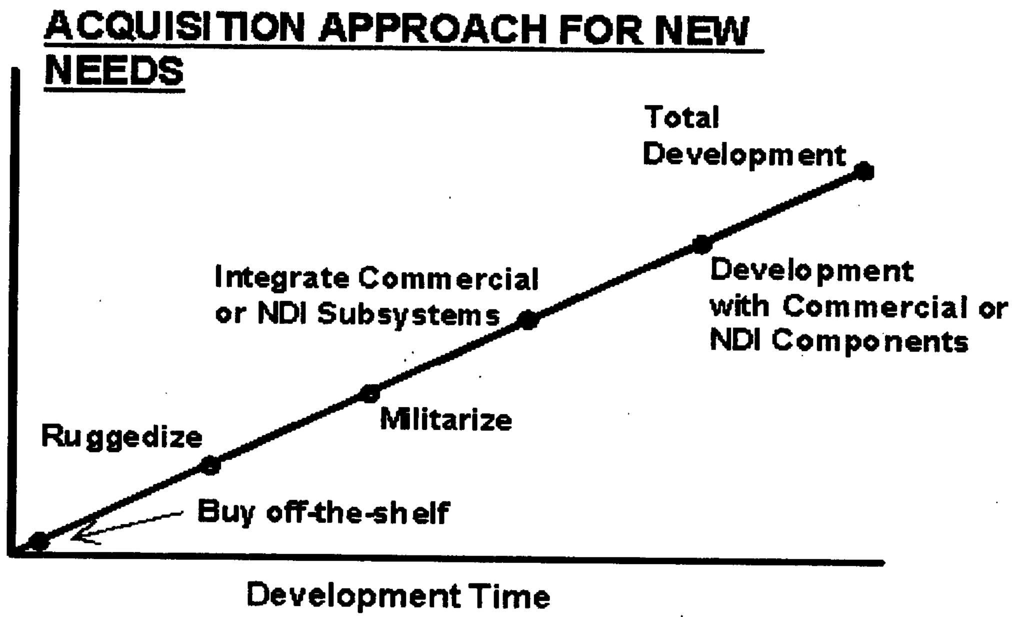


Figure 4-2. ***Commercial Item/NDI Spectrum*****, (DoD, 1998)**

The horizontal axis represents development time such that the more development required within a program, the greater the schedule needs to be to accommodate the requirement. On the other hand, a commercially available item could be employed readily. Interestingly enough, the vertical axis is not labeled in the Defense Acquisition Deskbook. It would seem logical to appropriately label this axis any number of titles ranging from the most obvious *costs*, to *risks*, or even *difficulty*. Theoretically, buying a commercial item requires less time than a complete total development program. Notwithstanding, it takes a great deal of time to research a commercial item. It should be emphasized that a PM could

spend a great deal of time conducting market research on a product only to determine he'll have to spend a greater amount of time conducting a full scale development program.

By tapping dual-use technology, the PM can exploit a technology without having to develop it within his program. He can rely on a proven technology, or even a state-of-the-art technology. Furthermore, he could take that technology and make it better, improving on its quality. In the current trend of budget reductions, it seems pragmatic for a PM to maximize his production efforts by looking to existing technologies for use in his program. As Figure 4-3 depicts, the services seem to understand the benefits. To date, there have been quite a few transfers of technology. It appears that the emphasis from the Administration, the SECDEF and the legislature, as seen in Chapter III, has been effective. Although not explicit, the technology transfers depicted in Figure 4-3, include dual-use technologies transferred into a program as well as those transferred out of a program.

Not only does utilization of the commercial marketplace make sense from cost, schedule, and technology considerations; law also requires it. The Federal Acquisition Streamlining Act of 1994 (FASA) requires that Federal agencies, to the extent practicable,

Defense Department Technology Transfer Program

Number of Reported Active Technology Transfer Mechanisms*
per Service/Agency

Service	FY 1995	FY 1996
Army	552	639
Navy	148	139
Air Force	53	42
Defense Advanced Research Projects Agency	2	2
TOTAL	**755**	**822**

* Technology Transfer Mechanisms include Cooperative Research and Development Agreements (CRADAs), Patent License Agreements, Use of Facility Agreements, and Personnel Exchange Agreements.

Figure 4-3. DoD Technology Transfer Program

Source: Department of Defense Office of Technology Transfer, 1997.

- buy commercial items, commercial services, and nondevelopmental items to meet agency needs;
- require prime contractors and subcontractors at all levels to incorporate commercial and nondevelopmental items as components of systems they develop for Federal agencies;
- state specifications in terms that enable and encourage companies to supply commercial and nondevelopmental items; and
- revise procurement policies, practices, and procedures -- not required by law -- to remove impediments to the acquisition of commercial items.

Recent Acquisition Reform initiatives suggest a reduction of the "Defense" industrial base simultaneously with an increase in the "national" industrial base. U.S. Government reliance on existing technologies and products will result. Thus, DoD seems to be developing its dual-use technology policy in order to increase its interdependence with the commercial sector (DU S&T, 1998).

Exploring both commercial items and NDI becomes part of the decision process for any program manager and his staff. Figure 4-1, from earlier in this section, depicts a possible flow diagram of the consideration to use either commercial or nondevelopmental items.

That flow chart illustrates the program manager's decision points in selecting commercial, NDI or developmental technology. On the surface it appears a single yes or no decision cycle. Realistically, this decision cycle restarts for the subsystems and components. A more complete picture, however, includes the analysis involved with the pricing of such items. This is the topic of the next section.

2. How to Employ Dual-Use Technology

Early in the acquisition process, before the operational requirement document (ORD) is validated, for example, it is possible to compare the user's need to the capabilities of the commercial market and determine

- the availability of products to meet the requirement as is,

- the ability of suppliers to modify their products to meet the user's requirement, and
- the flexibility of users to modify their requirements to allow the purchase of commercial items, commercial services, or nondevelopmental items (DoD, 1998).

As the Congress and the American public continue to scrutinize the Department of Defense (DoD) budget, future acquisitions will be pressured to rely heavily on commercial and nondevelopmental items (NDI). The program manager faces several challenges when choosing these dual-use technologies in his acquisition strategy; one challenge is determining a fair and reasonable price for the item. Having introduced commercial items and NDI, the next step is to consider development of pricing data for dual-use technologies.

The procedures for the acquisition of NDI are neither new nor significantly different from established acquisition procedures. Thus, pricing CI/NDI becomes the major issue in employing dual-use technology. Therefore, how are dual-use technologies priced? Pricing CI/NDI is a good representation for pricing all dual-use technologies. Price or cost serves as the foundation of analytical decisions for dual-use employment. The primary goal in these cases is to obtain the best value in meeting the established requirements of the user (OASD(P&L), 1990). CI or NDI, just as any other acquisition approach, requires appropriate analysis in order to protect the buyer. CI/NDI offer a range of different potential solutions to the

need. Figure 4-2, from Section 1, depicts the spectrum of possible solutions for using both commercial items and NDI. Although the very ends of the spectrum are black and white, there exists a large, gray area in between new developments and off-the-shelf items. Within this gray area, CI or NDI solutions necessitate a trade-off analysis.

Current acquisition procedures require market research and analysis in order to determine the availability and suitability of commercial and nondevelopmental items prior to the commencement of any developmental effort, during the developmental effort, and prior to the preparation of any product description. The DoD 5000.2-R, *Mandatory Procedures for Major Defense Acquisition Programs and Major Automated Information System Acquisition Programs*, outlines these procedures (DoD, 1998). Market research is also an important tool for identifying and buying dual-use technologies, when suitable commercial items are not available.

Market research is essential to optimize the potential use of commercial items, commercial services, and nondevelopmental items to meet agency needs. Figure 4-4 depicts the broad range of considerations to be answered by market research. These considerations broaden and clarify DoD's understanding of potential CI or NDI solutions. Thorough market research may result in a fair and reasonable price for the Government.

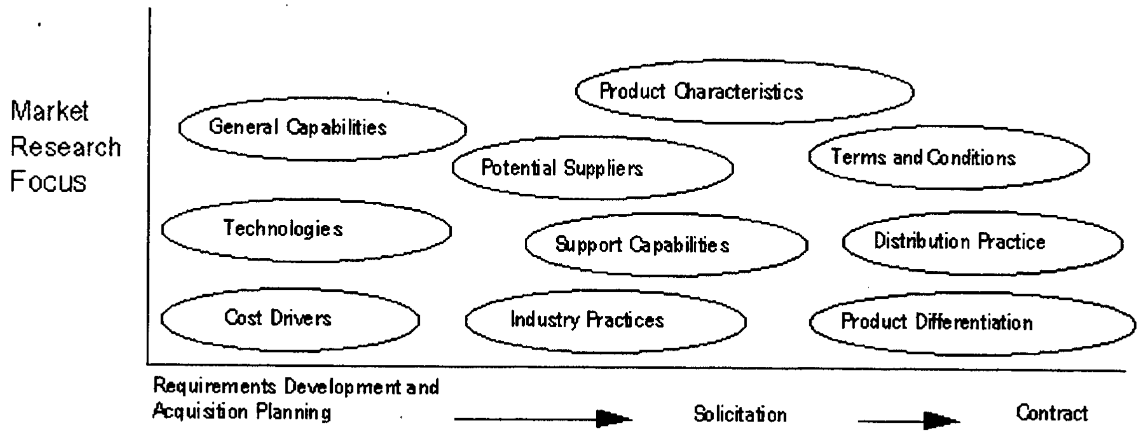


Figure 4-4. ***The Focus of Market Research*, (OUSD(A&T), 1997)**

Market research has two phases: market surveillance and market investigation. Market surveillance is an ongoing process and includes all the activities that acquisition personnel perform continuously to keep themselves abreast of technology and product developments in their areas of expertise. Market investigation, which involves more comprehensive research, is conducted in response to a specific materiel need or need for services (DA, 1995).

<u>Primary Sources For Market Surveillance Information and Data</u>

(DAF)

- Industry publications, catalogs, and product data sheets.
- Independent research and development reports and presentations.
- Participation in professional societies and related activities.
- Counterparts in other military services. (See DoD Pamphlet SD-1, "Standardization Directory.")

- Trade shows and industry workshops.
- Discussions with industry representatives.
- Foreign military data exchange.
- Journals.
- Internet

The market investigation team should include representatives of the groups who will significantly influence the program as it progresses. These team members may include:

- Potential vendors.
- Users.
- Operational and development testers.
- Logistics specialists.
- Life cycle cost analysts.
- Program managers and engineers (OUSD(A&T), 1997).

This list, of course, is not all-inclusive.

Figure 4-5 portrays the essential elements of market investigation. These elements will provide the best picture for determining a fair and reasonable price of a particular NDI. A thorough market investigation truly dictates the contracting officer's thorough understanding of NDI use.

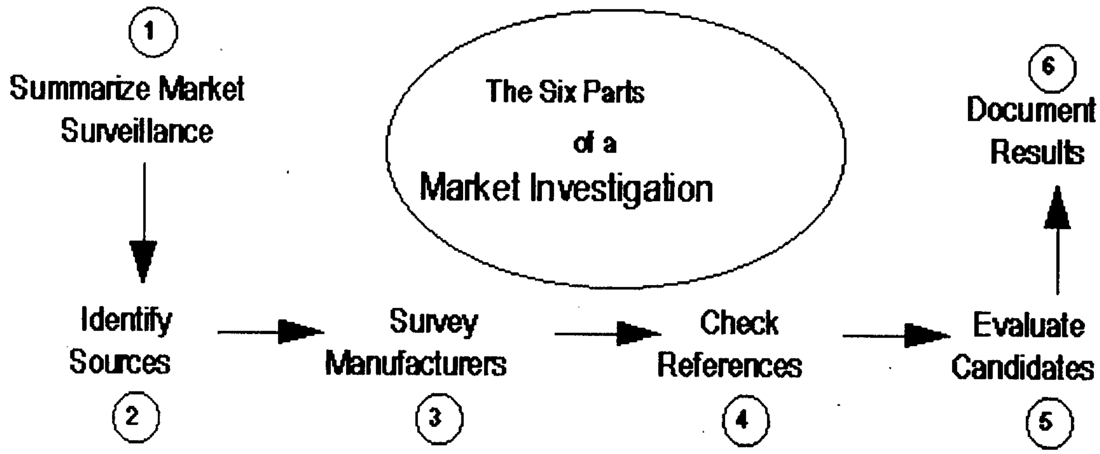


Figure 4-5. ***Market Investigation Make-up*, (DoD, 1998)**

3. Dual-Use Technology Resources

Section 1 of this chapter demonstrated why a PM should employ dual-use technologies within his program. Section 2 showed how that should be done. This section explains the various resources available to assist a PM and his staff in acquiring systems. Finally, it is followed by a case in which dual-use technology was successfully employed.

First, this section will detail how a PM must still be conscious of the historical perception of dual-use technology. He can use some existing resources, as he must remain wary of technology transfers out of his program. Next, this section presents some additional resources available to the PM and his staff in implementing the current trends in dual-use technology. He may then be able to

use existing technologies within his program without having to initiate a totally developmental program.

As a result of the former preoccupation with the prevention of unintended dual-use technologies, the PM had to bear the burden of the costs of the entire program. Thus, the PM often missed beneficial opportunities of both cooperative efforts and foreign military sales. Although, the name of the game is now to be the beneficiary of the advantages of the technologies of others in order to ultimately reduce risks, foreign military sales still have a critical place in programs.

As a result of FMS, PMs must still be wary of the implications of transferring dual-use technologies as outlined in Chapter II. However, in some cases, especially when a program plans to employ commercial items within its acquisition strategy, foreign military sales may be practical. Some resources exist to help the program office in this endeavor.

There are numerous wickets that the program office must get through in order to make the FMS effective. However, the PM may have security assistance resources available to his office in order to assist in FMS. But first, PMs need to have an understanding of what are the critical military technologies associated with dual-use technology to better use that assistance. Some of these include the following: (Stahlschmidt, 1989)

- Composites

- Stealth & Low Observables
- Large Scale Integrated Circuits
- Fiber Optics
- Command, Control and Communications Systems
- On-Board Computers

Not included in this particular list, but just as important, are the missile technologies that fall into the dual-use categories. A PM who understands the various aspects of critical and dual-use technologies, in addition to the resources available to him will be more effective. He will be able to leverage already developed technologies, maximizing their use in his program. By better understanding the technology, the PM can utilize resources better as well as make better decisions. In addition, he will then be able to determine when to employ FMS in his acquisition strategy.

Notwithstanding, the concept of foreign military sales is not without critics. Several articles in the *Early Bird* in 1998 have reported about how FMS to Israel further resulted in Israel transferring that technology to China. Some critics will argue that the U.S. will lose its technological edge if it continues to sell its current weapon systems to foreign countries. In addition, FMS made with the intention of "friendly" use could easily be turned to malicious means during times of crisis. Furthermore, some may argue that if we continue transferring these technologies,

all nations would eventually have them. Finally, the concerns of a PM for FMS may eventually become moot. Opall-Rome writing in *Defense Week* concluded that "the Emirates' [United Arab Emirates] decision to purchase the bulk of the 80-aircraft, $7 billion F-16 package through commercial channels hammered yet another nail in the coffin of FMS."[1] Interesting to note is that when, or if, the official U.S. Government sponsored FMS program becomes obsolete, the issues surrounding dual-use technology may even be exacerbated for the program office. The PM may not be able to reap the benefits of FMS through his program. Likewise, he may have to be a good customer to get the attention of the contractor.

However, FMS does not allow all technologies to be transferred. The PM needs to go to already established sources of information concerning certain technologies. As alluded to earlier, there are the critical military technologies, to include those on the Missile Technologies Control Regime (MTCR). These dual-use technologies are kept within the U.S. and its closest allies, in order to specifically prevent their malicious use. Albeit, they do have some very valuable peacetime uses, these technologies involve satellite/guided missile technologies. The concern for malicious use far outweighs the potential peacetime uses. Second, while some argue that the technological gap between nations today is closer, the

[1] The implications here are tremendous. Would a U.S. firm have to hire a specific staff to work within each potential nation's/customer's acquisition and contracting rules? Will that earn them more profits? The article also does not discuss the issues associated with direct military sales, its intricacies and working with other U.S. Government agencies other than DoD.

U.S. Defense complex is committed to maintaining technological superiority. Retired Colonel Dave Matthews, the former PM for ATACMS clearly indicated that certain missiles sold to foreign countries had their critical guidance components compartment welded shut (Matthews, 1997). This prevented the disclosure of a critical technology, and thereby reduced the aforementioned potential for future malicious use. However, other implications resulted in a long logistics train when the missile needed repairs on its guidance system. This logistics constraint impacts the planning and "sale-ability" of the program to a potential FMS customer. Even today, the U.S. has not let go of the old preoccupation, when considering FMS. The PM must look to the MTCR for approval to transfer or sell equipment in order to prevent malicious or unintended use of dual-use technologies.

The Defense Contract Management Command (DCMC) has recently defined another niche for it to provide assistance to the contracting officer. The DCMC can provide a valuable source of market analysis, "including (but not limited to) determining sources of commercial and nondevelopmental items and developing rough order of magnitude pricing estimates" on these type items. The DCMC's Early Contract Administration Services (CAS) Help Center can support contract officers in determining a fair and reasonable price for an NDI (DoD, 1998).

In addition to providing assistance to the contracting officer, this help center may also provide an excellent resource for the program office. As a program manager is in the early stages of reviewing potential material solutions to a battlefield deficiency, the DCMC Help Center could also serve to help in the cost, schedule and performance planning of the program. Figure 4-2 from Section 1, demonstrates that decision-making process. The analysis from DCMC's help center can assist the PM to meet the national objectives in using NDI. However, the PM's use of NDI in his program has far reaching implications.

Furthermore, PMs should not be overly alarmed if they are not yet educated about all aspects of dual-use technology. Major Karl R. Meuschke, in his 1996 Masters Degree thesis concluded that technology transfer “smart” people are necessary for program success (Meuschke, 1996). Additionally, the program office designee should obtain *A Program Office Guide to Technology Transfer* from the Defense Systems Management College. Furthermore, the *Defense Technology Transfer Working Group* (DTTWG) might provide valuable insight to the PM and Program Executive Officer (PEO). Such sources might contribute to the PM's ability to successfully employ dual-use technologies in his program.

Established in 1994, the DTTWG has representation from each of the Services as well as most of the Defense agencies. The Fiscal Year 1996 agenda

included the following: (Extracted from the DoD Office of Technology Transfer Annual Report, 1996)

- Passage of the National Technology Transfer and Advancement Act of 1995 and the attendant implementation of this law within the Department.

- Participation in the Federal Laboratory Consortium for Technology Transfer.

- Implementation of Dr. Perry's policy memorandum of June 2, 1995, on Domestic Technology Transfer and Dual Use Technology Development (Appendix 2).

- Use of and linkages between technology transfer homepages via Internet connections.

- Further development of a Defense Technology Transfer Information System.

- Initial meeting of the Department's Technology Transfer Senior Managers.

- Review of Best Practices/Lessons Learned on Technology Transfer processes.

The PM or even the PEO will probably not have direct access to this working group. However, the proceedings as well as various similar links are available electronically via the Internet, which can be valuable resources to the PM. In addition, other Technology Transfer Working Groups at lower levels will develop as the PM's plan takes effect. DTTWGs provide valuable insight for ideas of employing dual-use technologies.

C. LESSONS LEARNED

<u>THE ARMY SNIPER RIFLE: CASE & POINT</u>

Market research of NDI can help shape the requirement phase of the acquisition process. The Defense Acquisition Deskbook, (DAD) further depicts an example of how the Army used market research in determining its requirement. The draft requirement for the Army's M-24 Sniper Rifle required a probability of hit of .95 at 800 meters. Indications from market research revealed "the required probability of hit might be too high to attain." The acquisition team evaluating the market investigation data recommended relaxing the requirement. After review, the requirement of hit probability became a range between .85 and .95 at the 800-meter range. The team's logic was that .85 was at least comparable to the hit probability of the existing USMC M-40A1 sniper rifle. Furthermore, also based on their market research the team recommended reducing the service life of the weapon from 15,000 to 10,000 rounds (DoD, 1998).

The market research of NDI revealed a practical change to the requirement resulting in the Army understanding a great deal about the item, in particular, the appropriate price range. Although maximum use of commercial and NDI components and subsystems is encouraged, the Government developer should evaluate the risks of assuming the responsibility for integrating commercial and NDI components and subsystems into a complex system. Figure 4-1 from Section

1, demonstrates the risk factor of *time* in determining the degree to which commercial items and NDI are used.

However, modification of a commercial or non-developmental item results in a partial development effort and must be handled accordingly. Many of the cost, risk, schedule, and supportability benefits may be jeopardized as a result of modification, and it is important to reevaluate the use of a nondevelopmental or commercial item in light of the specific planned modifications. The test and logistics support plans must take the scope of the modification into account to ensure the success of the effort.

The cost of integrating several NDI or NDI into another program must not outweigh the benefits realized by using the NDI in the first place. The price of the NDI is one aspect of evaluating this cost benefit analysis. Other issues involve the supportability and maintainability of the particular items. The Army Sniper Rifle Case seems to portray an exemplar of dual-use technology employment.

D. CHAPTER SUMMARY

This chapter analyzed the factors impacting on a PM's decision to employ dual-use technology. It further studied the factors a PM considers in how he employs dual-use technology. Finally, it examined at the resources a PM could use in the application of dual-use technology in a system acquisition. The Army Sniper Rifle Case captures this analysis.

V. CONCLUSIONS AND RECOMMENDATIONS

A. INTRODUCTION

The objective of this thesis was to study the use of dual-use technologies within a program. To explore this subject, the researcher reviewed the historical perspective of dual-use technologies as well as the current trends in today's era. The researcher also analyzed the application of dual-use technologies. This chapter presents the conclusions of this thesis, offers recommendations, answers the primary and subsidiary research questions, and suggests areas for further research.

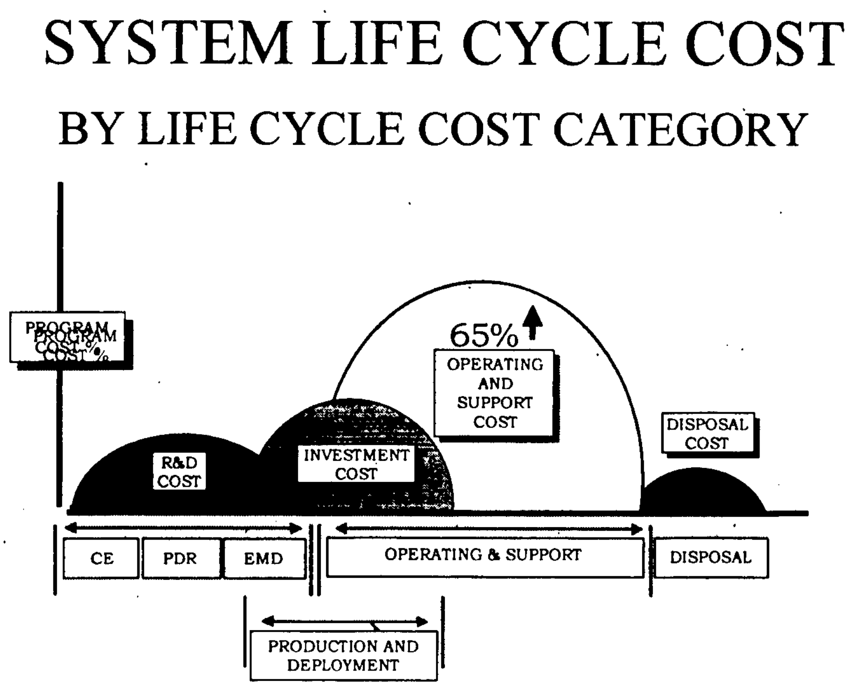
B. CONCLUSIONS

1. Dual-use technologies can provide the necessary cost savings to continue to produce leading-edge technologies during this era of reduced Defense budgets. The decision to employ dual-use technology must be made carefully and consciously.

Dual-use technology is essentially that technology which has both commercial and military use or capabilities. It may be an item, in the form of a CI or NDI, or it may be a process, having the ability to reduce production costs. Dual-use technologies help sustain the Defense and national industrial base. Some predominately Defense contractors, for example Lockheed Martin, have seen their research and development funds erode. They too look toward the possibilities of

partnering with the Government to reap any benefits they can as they attempt to commercialize products.

The funding efforts of the Technology Reinvestment Program, and now the Dual Use Science and Technology Program, demonstrate DoD's desires and willingness to promote dual-use technology developments. Furthermore, with the waiver of specific rules within the program, such as FAR compliance, DoD effectively attract non-traditional DoD contractors. Attracting these contractors



Source: Boudreau, 1998

Figure 5-1

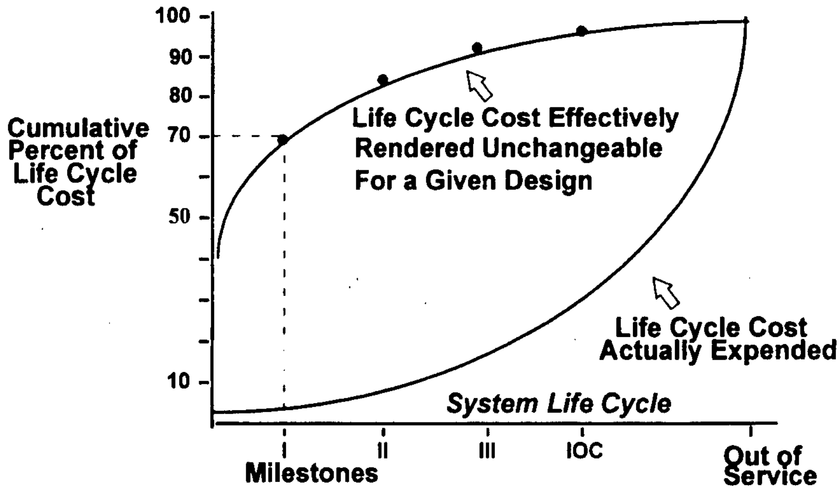
early in the acquisition cycle is imperative.

Based on the System Life Cycle Cost graph, Figure 5-1, we understand most program costs occur during the sustainment phases and are paid with Operations and Support (O&S) (Boudreau, 1998). Successful implementation of dual-use technology can effectively reduce the O&S bulge. In addition, a coordinated effort of DoD and the commercial sector can continue to successfully push the dual-use opportunities.

2. The application of dual-use technologies should be concentrated at the early stages of an acquisition strategy and implemented as early in the process as possible.

Based on the Early Decision chart, Figure 5-2, it is clear that most decisions that affect a program's life cycle costs are made rather early in its acquisition life (Boudreau, 1998). For example, 70% of decisions are made by Milestone I. In addition, we know that as changes are made later in a program, they cost more (Boudreau, 1998). [See Figure 5-3, The Benefits chart.] All of these expensive, critical decisions point to making the decisions about acquisition strategy carefully and decisively. More importantly, it means to take the time up-front and early, making calculated decisions for life cycle support. These decisions need to include early evaluation of dual-use technologies, from which crucial costs and design changes will be reduced.

EARLY DECISIONS AFFECT LIFE CYCLE COST

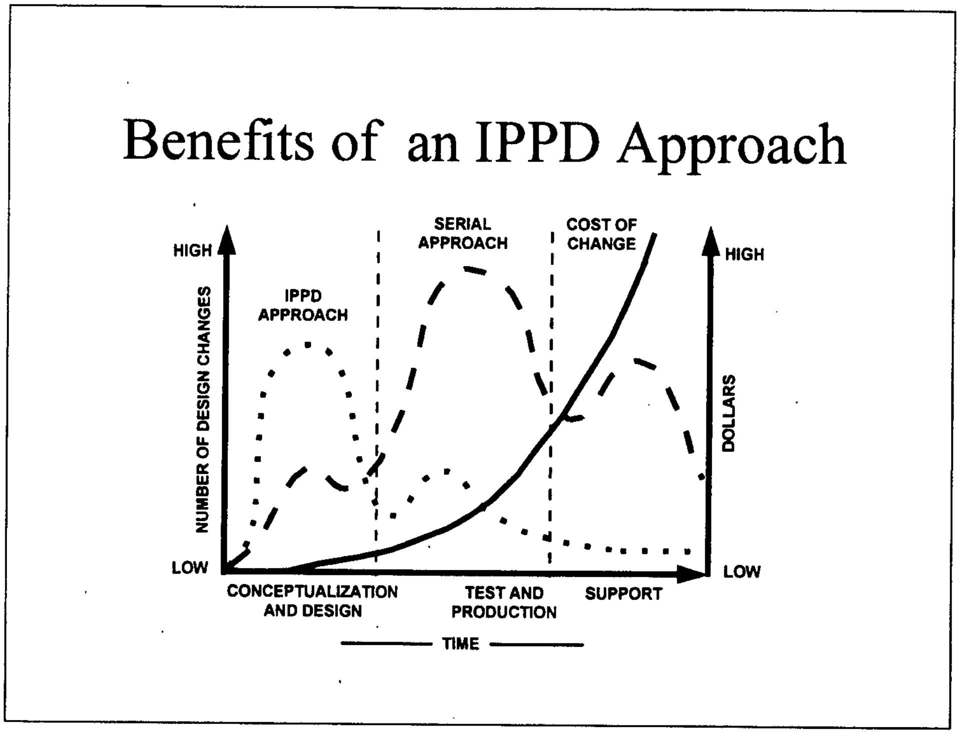


Source: Boudreau, 1998

Figure 5-2

3. **Market research is a key element in successful employment of a dual-use technology strategy.**

CI and NDI acquisition programs are in the current trend to procure items for Defense cheaper, faster and better than a full-scale development program. CI and NDI use is a potential solution to an acquisition that may offer significant payoffs in terms of cost and time because CI/NDI has already been developed and should also have an operating history (OASD(P&L), 1990). Understanding where and how CI/NDI fit into a program, as well as exploring the particular pricing information can reveal a great deal about the material solution. Poor market research may hinder appropriate application of CI/NDI to a battlefield deficiency.



Source: Boudreau, 1998 **Figure 5-3**

To counter this potential weakness, the program manager and contracting officer must ensure that thorough market surveillance and investigation are completed to identify CI/NDI solutions and to justify and validate the determined fair and reasonable price.

C. RECOMMENDATIONS

As a result of this research, the following recommendations are presented:

1. DoD needs to establish and maintain a centralized "clearinghouse" for dual-use technologies.

Establishing a coordinated effort for the application of dual-use technologies via the World Wide Web would continue to help the current trend of

dual-use technology initiatives. Section 2 of Chapter IV showed all of the various sources of market information. Yet, a centralized source would provide a valuable resource to PMs. It would provide the continuous availability of capabilities for the Program Manager to apply within his program. In addition, it would also apply to the inverse: PMs looking for a particular technological idea could essentially place a "want ad" requesting the commercial sector industries to cooperate and participate. Furthermore, this virtual "store" of technologies could share lessons learned and best practices in employing dual-use technologies.

2. Develop quantifiable metrics from which to measure success of a dual-use employment.

Section 3 of Chapter IV demonstrated the various resources to assist PMs in employing dual-use technology. However, very little follow-up has been done on how well those resources aided the dual-use employment.

Employing dual-use technologies seems to be a logical method of sustaining the industrial base during this reduced budget era. The Department of Defense needs to focus some effort on seeing how the employment of dual-use technologies has lowered cost, reduced schedule and provided a merging of the Defense and national industrial base. There seems to be a lack of quantifiable data to substantiate these benefits. Yet, the benefits are completely intuitive to many in the acquisition business.

3. **Base success of a program upon the substantial employment of dual-use technologies with the focus on early employment to save money in the procurement, and operations and support (O&S) of a program's life cycle costs. Look to see if the myriad of resources is providing quantifiable cost savings for the program office.**

Dual-use technology offers advantages to both the Government as well as the civilian sector in the form of lower costs and shared risks. The opportunities exist, primarily in the procurement and O&S costs to maximize scarce critical resources through an interdependence of the Defense and commercial sectors. Application of dual-use technologies can provide this necessary melding and ultimately substantiate total ownership cost reductions.

D. ANSWERS TO RESEARCH QUESTIONS

1. Primary Research Question: What is dual-use technology and how has it impacted program management?

As a form of technology transfer, dual-use technologies can assist a PM and his staff in meeting the cost, schedule and performance requirements of the program. Leveraging reduced cycle-time, lowered costs and proven technologies of dual-use items can also bring-in additional funds to the program office. Both Executive Order 12591 and the Secretary of Defense's June 1995 memorandum echo the importance of dual-use technologies. The DoD 5000 series repeats the same imperative that the PM shall employ dual-use technologies, and to the maximum extent possible.

To encourage the employment of dual-use technologies, current acquisition reforms include dual-use technology imperatives whereby a program office can win award seed money to further their initiatives. A PM and his staff must be familiar with the market trends in which their office exists. Consideration of dual-use technologies is a must for all program offices. However, successful employment may result in another set of equally difficult challenges. A program staff requiring more knowledge about dual-use initiatives can call 1-800-DUAL-USE to obtain additional guidance.

2. Subsidiary Research Question: What is the application of dual-use technology? How does dual-use technology apply to program management?

The mitigation of risks through avoidance is no longer a financially sound solution in program acquisition. It is simply too costly to do so. Thus, in some ways, the job of the PM is more difficult. He must temper the possibility of critical technology leakage with that of the benefits he may gain from its exploitation.

Moreover, the focus is now on borrowing others' technologies with less of a worry on what technologies are bleeding out from the program. If the PM can utilize mostly CI/NDI components or subsystems, he has to worry less about technology leaking from his program. As the reliance on CI and NDI increases, these concerns are naturally mitigated as the technology base for Defense and the

nation are mutually dependent. It does, however, create more of a difficult management problem for the program office.

3. Subsidiary Research Question: What is the relationship between the trend toward a national industrial base vice a Defense industrial base and dual-use technology?

Employment of dual-use technologies fosters the trend toward a joint industrial base. Any efforts, such as the TRP or DUS&T Program, can only prove to move closer towards a merged national and Defense industrial base. Substantial employment of CI and NDI over time will serve to meld the two sectors together.

4. Subsidiary Research Question: How do commercial items (CI) and non-developmental items (NDI) relate to dual-use technology?

Employment of dual-use technology essentially means the use of commercial and nondevelopmental items. This application should not only be in the form of a system, but can be in the component or subsystem level.

The October 1990 guide to buying [CI and] NDI explained

> ...an advantage to [CI and] NDI is that it usually has a performance history addressing these issues that can be used to reduce or eliminate additional efforts required to resolve them (OASD(P&L), 1990).

Although the document itself is somewhat dated, the quote holds true today. In addition, pricing history should similarly exist, further assisting the program manager in determining a fair and reasonable price. Part of market research includes exploring historical prices. The *Contract Pricing Reference Guide* details

some areas containing historical pricing data, which may be used during market research (CPRG, 1997-8). These data reflect a great deal of pricing factors to consider during market research.

Additionally, using CI/NDI has its risks. The program manager must ensure he has a complete understanding of the degree to which CI/NDI will be employed. Included in this understanding is having the answers to certain questions concerning pricing of the CI/NDI.[1] The primary intent of using NDI is to streamline the acquisition life-cycle process, greatly reducing the time to field a particular item. However, full and complete comprehension of the pricing associated with NDI will prepare the contracting officer in his quest toward obtaining a fair and reasonable price.

5. Subsidiary Research Question: What are the significant differences in procuring these items?

Market analysis is the key factor in procuring dual-use technologies. The program manager must be thoroughly knowledgeable about his product, specifically the technologies associated with it. He does not, however, need to be the technology expert. To get this intimate familiarity, the PM not only needs to get technology transfer-smart people in his program, but he needs to maintain his own understanding. To gain this understanding, he can look to trade journals,

[1] The CPRG outlines in great detail a list of questions that may be applicable to the contracting officer. It serves as an outstanding tool for him in the conduct of his market research.

trade shows as well as the Internet to stay abreast of the dual-use technology possibilities.

6. Subsidiary Research Question: What impact has dual-use technology had on the PMO and does it pose any significant problems for the program manager?

As the Clinton Administration and the Department of Defense (DoD) move toward greater reliance on technology transfer, the Program Manager must arm himself with a basic understanding of technology transfer. The issues of foreign military sales as well as the dual-use technologies are all inter-related into the over-arching issue of technology transfer.

The PM must then weigh the costs and benefits (advantages and disadvantages) in deciding on what technology transfer opportunities, if any, make sense for his program. He must fully understand the implications of FMS. The PM should review and consider collaborative efforts between the commercial and Defense efforts, assisting in the preservation of the U.S. industrial base.

After applying these initial factors to his particular program, the PM can then further focus in-depth efforts on achieving those specific technology transfer goals. Although this paper is not exhaustive, nor is it specifically detailed, it should provide a beginning to the technology transfer designee in a program management office. From here, the selected individual can converge on and research the applicable databases and procedures for the program office's needs.

7. Subsidiary Research Question: What is the relationship between dual-use technologies and technology transfer?

The concept of dual-use technologies has evolved over time. Any technology transfer from the commercial sector into the military or vice versa is considered a dual-use technology. Historically, PMs were concerned with the loss of critical technologies and their potential for future employment for malicious ends. Whereas this remains a concern, the focus for PMs today is to see what technology they can assimilate into their program from others, especially from the commercial sector.

The first issue involves the spread of technology from a PM's program to another source. This case was the greatest concern for the Government when the transfer was international and "denial" of a particular technology was imperative. The second perspective concerns a PM using already proven technology in his program. Since this technology exists, a PM who uses it can save money. As an integral part of dual-use technology, these two manners of technology transfer co-exist.

8. Subsidiary Research Question: May the U.S. Military lose its technological, competitive edge over its adversaries due to its dual-use initiatives?

The underlying concern for Defense acquisition is to use the most cost-effective source of supply throughout a system's life cycle. The desire to rely on the national industrial base for Defense acquisition should not pose a threat to U.S.

Defense capabilities. The Program manager has the responsibility to ensure thorough research is completed. "When there is an indication that industrial capabilities needed by DoD are in danger of being lost, [the program office] shall perform an analysis to determine whether government action is required to preserve an industrial capability vital to national security" (DoD, 1998).

The use of the MCTR may seem futile, because many countries eventually develop critical technologies over time. Yet, during the Cold War, it served its purpose of reducing or at least slowing the spread of crucial technologies in the missile delivery area. For the hawks that are still concerned about the spread of dual-use technologies, maybe the focus needs to be broadened to include other technologies. Be wary of the regulatory consequences. More bureaucracy for the PM will result in work-arounds instead of its intended purpose.

E. AREAS FOR FURTHER RESEARCH

1. Foreign companies involvement in the application of dual-use technologies.

The U.S. needs to balance its decision concerning critical technologies. Since it is clearly more cost effective to buy commercial items, it may seem practicable to look to potential foreign commercial items as well.

2. Review the measured effects of the TRP and predict the savings anticipated through its survivor, the Dual-Use Science and Technology Program.

As of October 1998, the results of the initial Technology Reinvestment Program were being collated (Petonito, 1998). An analysis of the anticipated cost savings could help predict future life cycle costs savings. In addition, it could help determine where to focus dual-use technology efforts and resources for the Dual Use Science and Technology Program.

F. CHAPTER SUMMARY

This chapter brought together the aspects of this thesis in some conclusions and recommendations about dual-use technology. It then answered the specific research questions this thesis setout to explore. Finally, in concluding the thesis, it posed some additional research areas for the basis of follow-on study.

APPENDIX A. EXECUTIVE ORDER 12591

Facilitating access to science and technology

**** Text or body of the decision or law ****

Source: The provisions of Executive Order 12591 of Apr. 10, 1987, appear at 52 FR 13414, 3 CFR, 1987 Comp., p. 220, unless otherwise noted.

By the authority vested in me as President by the Constitution and laws of the United States of America, including the Federal Technology Transfer Act of 1986 (Public Law 99 - 502), the Trademark Clarification Act of 1984 (Public Law 98 - 620), and the University and Small

Business Patent Procedure Act of 1980 (Public Law 96 - 517), and in order to ensure that Federal agencies and laboratories assist universities and the private sector in broadening our technology base by moving new knowledge from the research laboratory into the development of new products and processes, it is hereby ordered as follows:

Section 1. Transfer of Federally Funded Technology.

(a) The head of each Executive department and agency, to the extent permitted by law, shall encourage and facilitate collaboration among Federal

laboratories, State and local governments, universities, and the private sector, particularly small business, in order to assist in the transfer of technology to the marketplace.

(b) The head of each Executive department and agency shall, within overall funding allocations and to the extent permitted by law:

(1) delegate authority to its government-owned, government-operated Federal laboratories:

(A) to enter into cooperative research and development agreements with other Federal laboratories, State and local governments, universities, and the private sector; and

(B) to license, assign, or waive rights to intellectual property developed by the laboratory either under such cooperative research or development agreements and from within individual laboratories.

(2) identify and encourage persons to act as conduits between and among Federal laboratories, universities, and the private sector for the transfer of technology developed from Federally funded research and development efforts;

(3) ensure that State and local governments, universities, and the private sector are provided with information on the technology, expertise, and facilities available in Federal laboratories;

(4) promote the commercialization, in accord with my Memorandum to the Heads of Executive Departments and Agencies of February 18, 1983, of patentable results of Federally funded research by granting to all contractors, regardless of size, the title to patents made in whole or in part with Federal funds, in exchange for royalty-free use by or on behalf of the government;

(5) administer all patents and licenses to inventions made with Federal assistance, which are owned by the non-profit contractor or grantee, in accordance with Section 202(c)(7) of Title 35 of the United States Code as amended by Public Law 98 - 620, without regard to limitations on licensing found in that section prior to amendment or in Institutional Patent Agreements now in effect that were entered into before that law was enacted on November 8, 1984, unless, in the case of an invention that has not been marketed, the funding agency determines, based on information in its files, that the contractor or grantee has not taken adequate steps to market the inventions, in accordance with applicable law or an Institutional Patent Agreement;

(6) cooperate, under policy guidance provided by the Office of Federal Procurement Policy, with the heads of other affected departments and agencies in the development of a uniform policy permitting Federal contractors to retain rights to software, engineering drawings, and other technical data generated by Federal

grants and contracts, in exchange for royalty-free use by or on behalf of the government.

[Sec. 1 amended by EO 12618 of Dec. 22, 1987, 52 FR 48661, 3 CFR, 1987 Comp., p. 262]

Sec. 2. Establishment of the Technology Share Program.

The Secretaries of Agriculture, Commerce, Energy, and Health and Human Services and the Administrator of the National Aeronautics and Space Administration shall select one or more of their Federal laboratories to participate in the Technology Share Program. Consistent with its mission and policies and within its overall funding allocation in any year, each Federal laboratory so selected shall:

(a) Identify areas of research and technology of potential importance to long- term national economic competitiveness and in which the laboratory possesses special competence and/or unique facilities;

(b) Establish a mechanism through which the laboratory performs research in areas identified in Section 2(a) as a participant of a consortium composed of United States industries and universities. All consortia so established shall have, at

a minimum, three individual companies that conduct the majority of their business in the United States; and

(c) Limit its participation in any consortium so established to the use of laboratory personnel and facilities. However, each laboratory may also provide financial support generally not to exceed 25 percent of the total budget for the activities of the consortium. Such financial support by any laboratory in all such consortia shall be limited to a maximum of $5 million per annum.

Sec. 3. Technology Exchange -- Scientists and Engineers.

The Executive Director of the President's Commission on Executive Exchange shall assist Federal agencies, where appropriate, by developing and implementing an exchange program whereby scientists and engineers in the private sector may take temporary assignments in Federal laboratories, and scientists and engineers in Federal laboratories may take temporary assignments in the private sector.

Sec. 4. International Science and Technology.

In order to ensure that the United States benefits from and fully exploits scientific research and technology developed abroad,

(a) The head of each Executive department and agency, when negotiating or entering into cooperative research and development agreements and licensing arrangements with foreign persons or industrial organizations(where these entities are directly or indirectly controlled by a foreign company or government), shall, in consultation with the United States Trade Representative, give appropriate consideration:

(1) to whether such foreign companies or governments permit and encourage United States agencies, organizations, or persons to enter into cooperative research and development agreements and licensing arrangements on a comparable basis;

(2) to whether those foreign governments have policies to protect the United States intellectual property rights; and

(3) where cooperative research will involve data, technologies, or products subject to national security export controls under the laws of the United States, to whether those foreign governments have adopted adequate measures to prevent the transfer of strategic technology to

destinations prohibited under such national security export controls, either through participation in the Coordinating Committee for Multilateral Export Controls (COCOM) or through other international agreements to which the United States and such foreign governments are signatories.

(b) The Secretary of State shall develop a recruitment policy that encourages scientists and engineers from other Federal agencies, academic institutions, and industry to apply for assignments in embassies of the United States; and

(c) The Secretaries of State and Commerce and the Director of the National Science Foundation shall develop a central mechanism for the prompt and efficient dissemination of science and technology information developed abroad to users in Federal laboratories, academic institutions, and the private sector on a fee-for-service basis.

Sec. 5. Technology Transfer from the Department of Defense.

Within 6 months of the date of this Order, the Secretary of Defense shall identify a list of funded technologies that would be potentially useful to United States industries and universities. The Secretary shall then accelerate efforts to make these technologies more readily available to United States industries and universities.

Sec. 6. Basic Science and Technology Centers.

The head of each Executive department and agency shall examine the potential for including the establishment of university research centers in

engineering, science, or technology in the strategy and planning for any future research and development programs. Such university centers shall be jointly funded by the Federal Government, the private sector, and, where appropriate, the States and shall focus on areas of fundamental research and technology that are both scientifically promising and have the potential to contribute to the Nation's long-term economic competitiveness.

Sec. 7. Reporting Requirements.

(a) Within 1 year from the date of this Order, the Director of the Office of Science and Technology Policy shall convene an interagency task force comprised of the heads of representative agencies and the directors of representative Federal laboratories, or their designees, in order to identify and disseminate creative approaches to technology transfer from Federal laboratories. The task force will report to the President on the progress of and problems with technology transfer from Federal laboratories.

(b) Specifically, the report shall include:

(1) a listing of current technology transfer programs and an assessment of the effectiveness of these programs;

(2) identification of new or creative approaches to technology transfer that might serve as model programs for Federal laboratories;

(3) criteria to assess the effectiveness and impact on the Nation's economy of planned or future technology transfer efforts; and

(4) a compilation and assessment of the Technology Share Program established in Section 2 and, where appropriate, related cooperative research and development venture programs.

Sec. 8. Relation to Existing Law.

Nothing in this Order shall affect the continued applicability of any existing laws or regulations relating to the transfer of United States technology to other nations. The head of any Executive department or agency may exclude from consideration, under this Order, any technology that would be, if transferred, detrimental to the interests of national security.

APPENDIX B. THE SECRETARY OF DEFENSE

WASHINGTON, THE DISTRICT OF COLUMBIA
2 JUN 1995

MEMORANDUM FOR SECRETARIES OF THE MELITARY DEPARTMENTS

CHAIRMAN OF THE JOINT CHIEFS OF STAFF

UNDER SECRETARIES OF DEFENSE

DIRECTOR, DEFENSE RESEARCH AND ENGINEERING

ASSISTANT SECRETARIES OF DEFENSE

GENERAL COUNSEL

INSPECTOR GENERAL

DIRECTOR OF OPERATIONAL TEST AND EVALUATION ASSISTANTS OF ADMIMSTRATION AND MANAGEMENT DIRECTORS OF DEFENSE AGENCIES

SUBJECT: DoD Domestic Technology Transfer/Dual Use Technology Development Domestic Technology Transfer and Dual Use Technology Development (DTT/DUTD) are integral elements of the Department's pursuit of its national security mission. They must have a priority role in all DoD acquisition

programs and must be recognized as key activities of the DoD laboratories, DoD Domestic Technology Transfer/Dual Use Technology Development encompass:

- Spin-off activities that demonstrate non-Defense, e.g. commercial, viability of technologies already developed or presently being developed for national security purposes. The primary purpose of these activities, which encompass much of what has been traditionally called "technology transfer", is to promote and make available existing DoD owned or developed technologies and technical infrastructure to a broad spectrum of non-Defense applications.

- Dual-use science and technology activities that develop technologies having both Defense and non-Defense applications.

- Spin-on promotion activities that demonstrate the national security utility of technology developed outside of the DoD.

These activities are intended to ensure that DoD programs make the best possible use of national scientific and technical capabilities. Commercial availability of DoD developed technologies can be expected to lower the costs of acquiring military equipment by providing the opportunity to take advantage of economies of scale and buy from a much larger commercial industrial base. Concurrently, such activities ensure that the civil sector receives the maximum possible benefit from the nation's national security investments. This memorandum reinforces the importance of DTT/DUTD activities for

accomplishment of the DoD mission and defines oversight authority and procedures for their execution.

The Director, Defense Research and Engineering (DDR&E) is the oversight authority for execution of all DTT/DUTD science and technology matters. As appropriate, coordination will be accomplished with the Assistant Secretary for Economic Security on dual-use technology policy issues and with other DOD authorities for matters under their oversight.

In accordance with IO U.S. C ss 2 5 IS, DDR&E (acting through its Office of Technology Transition) is responsible for monitoring all DoD research, and development activities to identify technologies and technology advancements that have DTT/DUTD potential; serving as a clearinghouse for, coordinating and otherwise actively.facilitating technology transfers providing private firms with assistance in resolving problems impacting technology transfer; and coordinating with other Federal departments on matters involving technology transfer.

All DoD laboratories, as defined by 15 U. S. C. ss 3 7 1 Oa(d)2, and other organizations responsible for RDT&E activities must make DTT/DUTD a priority element in the accomplishment of their science and technology programs. Military department R&D executives, Defense agency directors, laboratory directors (and the executives to whom laboratory directors report) and other S&T managers are responsible for planning, budgeting and executing DTT/DUTD

programs and their performance appraisals will include evaluation of their organizations' DTT/DUTD activities.

As part of the DoD budget process, the DDR&E shall define core DTT/DUTD activities and provide policy guidance for component investments in these activities, coordinating with other DoD officials as appropriate. Core DTT/ DUTD activities shall include such items as:

- technology assessments to ascertain commercialization potential;
- DTT/DUTD marketing and outreach-
- engaging consultants to provide advice on technology transfer;
- payment of salaries and travel expenses of scientific, engineering, and legal personnel and Office of Research and Technology Application personnel involved In DTT/DUSD, to include costs associated with initiation/negotiation of Cooperative Research and Development Agreements (CRADAS) and other agreements;
- pilot spin-on demonstrations;
- DTT/DUTD training;
- payment of expenses associated with short-term technical assistance and consulting;
- development and maintenance of a 'comprehensive DoD-vAde DTT/DUTD database;
- funding the cost of accelerating patents; and

- administration of DTT/DUTD achievement awards.

As is current practice, other activities relevant to DTT/DUTD, such as DoD organizations' contributions to CRADAS (which must be consistent with the participating organizations I assigned missions), will be funded from the appropriate mission element funds or, in the case of Organizations that utilize Defense Business Operations Fund (DBOF) procedures, a program element for DTT/DUTD support. In line with the Department's new acquisition strategy, it is anticipated that steadily increasing percentages of RDT&E and other acquisition investments will involve cooperative partnerships and other efforts that involve dual-use technology development and spin-off and spin-on of technologies.

The Military Departments and components designated by DDR&E shall submit an annual report to DDR&E in time for the President's budget submission covering all laboratory and other organizations' technology transfer activities for the year preceding the date of the report. This report shall include both budgetary data and descriptions of achievements in technology transfer.

In coordination with appropriate authorities within OSD, DDR&E will develop more detailed guidance for DTT/ DUTD, to include matters related to the personnel and awards systems, acquisition reform and legal concerns.

This memorandum supersedes any confiding provisions of existing Department of Defense Directives and guidance. The DDR&E, in coordination with the Director of Administration and Management and appropriate officials of the Department, shall prepare, for my approval, directives and/or revisions to directives to incorporate the substance of this memorandum in the Department of Defense Directives System.

William J. Perry

APPENDIX C. TECHNOLOGY TRANSFER LEGISLATIVE HISTORY

Stevenson-Wydler Technology Innovation Act of 1980 (PL 96-480)[15 USC 3701-3714]

- Focused on dissemination of information.
- Required Federal Laboratories to take an active role in technical cooperation.
- Established Offices of Research and Technology Application at major Federal laboratories.
- Established the Center for the Utilization of Federal Technology (in the National Technical Information Service).

Bayh-Dole Act of 1980 (PL 96-517)

- Permitted universities, not-for-profits, and small businesses to obtain title to inventions developed with governmental support.
- Provided early on intellectual property rights protection of invention descriptions from public dissemination and FOIA.
- Allowed government-owned, government-operated (GOCO) laboratories to grant exclusive licenses to patents.

Small Business Innovation Development Act of 1982 (PL 97-219)

- Required agencies to provide special funds for small business R&D connected to the agencies' missions.

- Established the Small Business Innovation Research Program (SBIR)

Cooperative Research Act of 1984 (PL 98-462)

- Eliminated treble damage aspect of antitrust concerns of companies wishing to pool research resources and engage in joint precompetitive R&D.

- Resulted in Consortia: Semiconductor Research Corporation (SRC) and Microelectronics and Computer Technology Corporation (MCC), among others.

Trademark Clarification Act of 1984 (PL 98-620)

- Permitted decisions to be made at the laboratory level in government-owned, contractor-operated (GOCO) laboratories as to the awarding licenses for patents.

- Permitted contractors to receive patent royalties for use in R&D, awards, or for education.

- Permitted private companies, regardless of size, to obtain exclusive licenses.

- Permitted laboratories run by universities and non-profit institutions to retain title to inventions within limitations.

Japanese Technical Literature Act of 1986 (PL 99-382)

- Improved the availability of Japanese science and engineering literature in the U.S.

Federal Technology Transfer Act of 1986 (PL 99-502)

- Made technology transfer a responsibility of all Federal laboratory scientists and engineers.

- Mandated that technology transfer responsibility be considered in employee performance evaluations.

- Established principle of royalty sharing for Federal inventors (15% minimum) and set up a reward system for other innovators.

- Legislated a charter for Federal Laboratory Consortium for Technology Transfer and provided a funding mechanism for that organization to carry out its work.

- Provided specific requirements, incentives and authorities for the Federal Laboratories.

- Empowered each agency to give the director of GOCO laboratories authority to enter into cooperative R&D agreements and negotiate licensing agreements with streamlined headquarters review.

- Allowed laboratories to make advance agreements with large and small companies on title and license to inventions resulting from Cooperative R&D Agreements (CRDAs) with government laboratories.

- Allowed Directors of GOGO laboratories to negotiate licensing agreements for inventions made at their laboratories.

- Provided for exchanging GOGO laboratory personnel, services, and equipment with their research partners.

- Made it possible to grant and waive rights to GOGO laboratory inventions and intellectual property.

- Allowed current and former Federal employees to participate in commercial development, to the extent there is no conflict of interest.

Malcom Baldrige National Quality Improvement Act of 1987 (PL 100-107)

- Established categories and criteria for the Malcom Baldrige National Industry Award.

Executive Orders 12591 and 12618 (1987): Facilitating Access to Science and Technology

- Promoted the commercialization of science and technology.

Omnibus Trade and Competitiveness Act of 1988 (PL 100-418)

- Placed emphasis on the need for public/private cooperation on assuring full use of results and resources.
- Established centers for transferring manufacturing technology.
- Established Industrial Extension Services within states and an information clearinghouse on successful state and local technology programs.
- Changed the name of the National Bureau of Standards to the National Institute of Standards and Technology and broadened its technology transfer role.
- Extended royalty payment requirements to non-government employees of Federal laboratories.

- Authorized Training Technology Transfer centers administered by the Department of Education.

National Institute of Standards and Technology Authorization Act for FY 1989 (PL 100-519)

- Established a Technology Administration within the Department of Commerce.

- Permitted contractual consideration for rights to intellectual property other than patents in cooperative research and development agreements.

- Included software development contributors eligible for awards.

- Clarified the rights of guest worker inventors regarding royalties.

Water Resources Development Act of 1988 (PL 100-676)

- Authorized Army Corps of Engineers laboratories and research centers to enter into cooperative research and development agreements.

- Allowed the Corps to fund up to 50% of the cost of the cooperative project.

National Competitiveness Technology Transfer Act of 1989 (PL 101-189)(included as Section 3131 et seq. of DoD Authorization Act for FY 1990)

- Granted GOCO Federal laboratories opportunities to enter into CRDAs and other activities with universities and private industry,

under essentially the same ways as highlighted under the Federal Technology Transfer Act of 1986.

- Allowed information and innovations, brought into, and created through cooperative agreements to be protected from disclosure.

- Provided a technology transfer mission for the nuclear weapons laboratories.

Defense Authorization Act for FY1991 (PL 101-510)

- Established model programs for national Defense laboratories to demonstrate successful relationships between Federal government, state and local governments, and small businesses.

- Provided for a Federal laboratory to enter into a contract or memorandum of understanding with a partnership intermediary to perform services related to cooperative or joint activities with small businesses.

- Provided for development and implementation of a National Defense Manufacturing Technology Plan.

Intermodal Surface Transportation Efficiency Act of 1991 (PL 102-240)

- Authorized the Department of Transportation to provide not more than 50% of the cost of CRADAs for highway research and development.

- Encouraged innovative solutions to highway problems and stimulated the marketing of new technologies on a cost shared basis of more than 50% if there is substantial public interest or benefit.

American Preeminence Act 1991 (PL 102-245)

- Extended FLC mandate, removed FLC responsibility for conducting a grant program, and required the inclusion of the results of an independent annual audit in the FlC Annual Report to Congress and the President.

- Included intellectual property as potential contributions under CRADAs.

- Required the Secretary of Commerce to report on the advisability of authoring a new form of CRADA that permits Federal contributions of funds.

- Allowed laboratory directors to give excess equipment to educational institutions and nonprofit organizations as a gift.

Small Business Technology Transfer (STTR) Program 1992 (PL 102-564)

- Established a 3 year pilot program - Small Business Technology Transfer (STTR), at DoD, DoE, HHS, NASA, and NSF.

- Directed the Small Business Administration (SBA) to oversee and coordinate the implementation of the STTR Program.

- Designed the STTR similar to the Small Business Innovation Research SBIR program.

- Required each of the five agencies to fund cooperative R&D projects involving a small company and a researcher at a university, Federally-funded research and development center, or nonprofit research center.

National Department of Defense Authorization Act for 1993 (PL 102-25)

- Facilitated and encouraged technology transfer to small businesses.

National Department of Defense Authorization Act for FY 1993 (PL 102-484)

- Established the DoD Office of Technology Transition
- Extended the streamlining of small business technology transfer procedures for non-Federal laboratory contractors.
- Directed DoE to issue guidelines to facilitate technology transfer to small businesses.
- Extended the potential for CRADAs to some DoD-funded Federally Funded Research and Development Centers (FFRDCs) not owned by the government.

National Department of Defense Authorization Act for 1994 (PL 103-160)

- Broadened the definition of a laboratory to include weapons production facilities of the DoE.

National Techn. .ogy Transfer and Advancement Act of 1995 (PL 104-113) [also known as the "Morella Act"]

APPENDIX D. ACRONYMS

AE	Acquisition Executive
CAS	Contract Administration Services
CI	Commercial Item
CPRG	Contract Pricing Reference Guide
CRADA	Cooperative Research and Development Agreement
DAD	Defense Acquisition Deskbook
DARPA	Defense Advanced Research Projects Agency (formerly ARPA)
DISAM	Defense Institute for Security Assistance Management
DOD	Department of Defense
DODD	Department of Defense Directive
DSMC	Defense Systems Management College
DTIC	Defense Technical Information Center
DTTWG	Defense Technology Transfer Working Group
DU S&TP	Dual Use Science & Technology Program
DUAP	Dual Use Applications Program
EA	Evolutionary Acquisition
FAR	Federal Acquisition Regulation
FASA	Federal Acquisition Streamlining Act of 1994
FMS	Foreign Military Sales
IPPD	Integrated Product and Process Development

IPT	Integrated Product Team
MTCR	Missile Technology Control Regime
NDI	Nondevelopmental Item
OASD (P&L)	Office of the Assistant Secretary of Defense (Production and Logistics)
OMB	Office of Management and Budget
ORD	Operational Requirements Document
O&S	Operations and Support
OUSD (A&T)	Office of the Under Secretary of Defense (Acquisition and Technology
PEO	Program Executive Officer
PM	Program Manager
PMO	Program Management Office
SECDEF	Secretary of Defense
SD	Standardization Document
TRP	Technology Reinvestment Program
UAE	United Arab Emirates

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